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October 1, 1964

Distribution and Taxonomy of Mammals of Nebraska

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BY

J. KNOX JONES, JR.

University of Kansas
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University of Kansas Publications, Museum of Natural History
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Distribution and Taxonomy of Mammals of Nebraska

BY

J. KNOX JONES, JR.

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INTRODUCTION

Nebraska (area 77,227 square miles) extends from the oak-hickory forest along the Missouri River in the southeast, where the elevation is less than 900 feet, to the pine-clad hills and ridges of the Panhandle, some of which exceed 5000 (the highest is 5340) feet in elevation and are outlying foothills of the Rocky Mountain system. Interposed between these two extremes are the prairies—the true prairie, or tall-grass prairie, of the Central Lowlands and the mixed prairie of the Great Plains, including the unique Sand Hills that occupy more than 18,000 square miles to the north of the Platte River in the central part of the state. In Nebraska, therefore, mammals of the eastern part of temperate North America mingle with those of the grasslands, and to a lesser extent with species having northern, western or southern affinities. Consequently it is not surprising that 54 of the 81 species of native mammals occurring in the state reach distributional limits there.

The earliest published references to mammals in Nebraska are in the accounts of explorers, fur traders and missionaries who visited the plains region in the 17th and 18th centuries, but it was not until the 19th Century that systematic biological exploration of the state was really begun. Notable among the explorers and naturalists who visited Nebraska between 1800 and 1850, most of whom traversed the Missouri River, were Captains Lewis and Clark in 1804 and 1806, John Bradbury and Henry M. Brackenridge in 1811, Maximilian (Wied-Neuwied) in 1833-34, and John J. Audubon in 1843. By far the most important of the early explorations of Nebraska, however, was that of Major Stephen H. Long in 1819 and 1820. His party, which included naturalists Thomas Say and Edwin James, spent the winter at the so-called Engineer Cantonment, along the Missouri River in what is now southeastern Washington County, and in the spring of 1820 crossed Nebraska along the Platte River on the way to the Rocky Mountains. James' (1823) account of this expedition includes descriptions of six mammals from Nebraska in footnotes by Say and also a synoptic list of mammals found by the group. This report and others are of special interest also because they describe the then existing biotic conditions, which differed greatly from those prevailing today.

After the discovery of gold in California in 1849, the Platte Valley became one of the principal routes of travel to the west, leading to increased military activity there for the protection of travelers.

Also, survey parties were active seeking the best routes for military wagon roads and later for railroads. The specimens accumulated through the efforts of F. T. Bryan, J. G. Cooper, F. V. Hayden, G. K. Warren, and W. S. Wood, to name a few who were associated with the various military enterprises, were reported by Baird (1858) and Coues and Allen (1877) among others. Unfortunately, the localities of capture of some of these valuable specimens were only vaguely defined, and others have been incorrectly located by mammalogists owing to changes in political boundaries after the collections were made.

Nebraska Territory was created as a result of the Kansas-Nebraska Act of 1854, and from 1854 to 1861 included all lands between the 40th parallel and the Canadian boundary that were west of the Missouri River and east of the crest of the Rocky Mountains—in other words, what is now Nebraska, northeastern Colorado, and most of the Dakotas, Wyoming and Montana. With the establishment of Dakota Territory in 1861, Nebraska Territory was reduced to Nebraska proper and that part of Wyoming between the 41st and 43rd parallels and east of the 110th meridian. In March, 1863, the present boundaries of Nebraska were fixed. Many specimens obtained in the period 1854-63, properly labeled at the time as from "Nebraska," came from places in other states as their boundaries currently are recognized. Specimens labeled as from "Ft. Pierre" [South Dakota], "Ft. Buford" [North Dakota], "Milk River" [Montana], or "Ft. Laramie" [Wyoming], for example, pose no problem because the localities are well known; specimens from places less well known, such as "Deer Creek" (Jones, 1958*b*), or that were labeled with reference to a general locality, such as "Platte River," do pose problems and require the routes and dates of travel by the parties concerned in order to place them accurately on modern maps. Insofar as was possible I have admitted for Nebraska only those records that I could convince myself actually originated there.

More than 200 books and scientific papers have been published in which reference was made to mammals in Nebraska, most of which are listed at the end of this account. The first published list of mammals of the state was by Samuel Aughey (1880) in his "Sketches of the physical geography and geology of Nebraska." But this list contained little original information, being mostly a compilation, with liberal extrapolation, from the compendia of Baird and of Coues and Allen cited previously. The only other

paper treating mammals on a state-wide basis, except the four checklists of Myron Harmon Swenk (1915*c*, 1918, 1919, and 1920*b*) and one of my own (1957), was Swenk's "A preliminary review of the mammals of Nebraska, with synopses," which appeared in 1908 and in which 92 kinds were listed. Of the serial publications in which papers dealing with Nebraska have appeared, three, the North American Fauna series (1889-present), the Journal of Mammalogy (1919-present) and the University of Kansas Publications, Museum of Natural History (1946-present), are of particular note.

In addition to published sources I have had available two unpublished manuscripts of considerable import. One, "The mammals of Nebraska" by the late Merritt Cary, written about 1905, was made available to me in Washington, D. C., by Stanley P. Young of the U. S. Fish and Wildlife Service. The other, a collection of notes on Nebraskan mammals compiled over a period of more than 50 years by the late Myron H. Swenk, is now in my possession through the courtesy of Edson H. Fichter. A number of citations have been taken from each manuscript.

My own work in Nebraska began in the summer of 1946 and, save for 1954 when military service took me out of the country, I collected at least some mammals in the state in each year through 1961. Principal collections were made in the summers of 1947, 1948, 1952, and 1957, and by J. R. Alcorn in the spring of 1958. In the course of this study, nearly all specimens of Nebraskan mammals in North American museums that came to my attention prior to March 31, 1962, were examined—a total of 10,339. The few specimens of which I was aware that, for one reason or another, were not personally examined generally are duplicated among specimens in other collections.

It is axiomatic that a study of the kind here reported on is but a progress report. Much remains to be learned concerning the distribution and speciation of mammals in Nebraska and mention is made in the text beyond of some remaining problems. Lest I be criticised for preparing this report mainly from the taxonomic and distributional approach, I would remind the reader that little precise information currently is available concerning the ecology of Nebraskan mammals (the studies of Fichter *et al.*, 1955, Mohler *et al.*, 1951, and Sather, 1958, being notable exceptions), and it is hoped that this work will stimulate biologists to undertake such studies.

ENVIRONMENT

CLIMATE

The climate of Nebraska is typical of that of the interior of large continents and is characterized by sparse to moderate rainfall, low humidity, hot summers, cold winters, wide variations in temperature and rainfall from year to year, and not infrequent drastic changes in weather from day to day. The two major factors influencing climate in the state are (1) its interior location continentally, far distant from large bodies of warm water, and (2) its situation in the rain shadow to the east of a high, north-south mountain system.

Short-period changes in weather are influenced by the invasion of large masses of air: warm, moist air from the Gulf of Mexico; hot, dry air from the southwest; cool, usually dry air from the north Pacific Ocean; or cold, dry air from interior Canada. Masses of air over Nebraska generally are associated with the eastward movement of high and low pressure systems (cyclones and anticyclones), which are influenced by the Rocky Mountains. Many cyclonic storms pass either to the north or the south of Nebraska. Air crossing the mountains at the latitude of Nebraska looses most of its

TABLE 1.—MEAN TEMPERATURE AND PRECIPITATION VALUES, 1905-1960, FOR SEVEN SELECTED WEATHER STATIONS, ARRANGED FROM EAST TO WEST (DATA FROM "LOCAL CLIMATOLOGICAL DATA" SHEETS, 1960, FOR THE STATIONS LISTED). TEMPERATURE IN DEGREES FAHRENHEIT; PRECIPITATION IN INCHES.

STATION (and altitude)	Temperature					Precipitation	
	Jan.* max.	Jan.* min.	July* max.	July* min.	Average annual	Average annual	Average snowfall**
Omaha (978 ft.)	31.0	13.3	87.5	67.4	51.2	28.05	29.15
Lincoln (1166 ft.)	33.3	14.7	89.0	66.6	51.8	27.62	29.83
Norfolk (1544 ft.)	29.5	8.0	87.0	63.4	48.3	23.56	28.93
Grand Island (1841 ft.)	34.1	12.9	90.6	64.8	50.9	24.61	28.80
Valentine (2587 ft.)	33.1	9.2	85.2	59.0	47.2	18.61	28.90
North Platte (2779 ft.)	36.0	11.7	87.6	62.2	49.4	18.42	31.64
Scottsbluff (3950 ft.)	39.8	11.9	89.2	57.4	48.5	15.30	39.68

* Average daily minima or maxima.
** Average 10 seasons (1950-51 to 1959-60).

moisture on the windward side of the Rockies and becomes warmer and drier as it descends the eastern slopes onto the plains.

Most (nearly 80 per cent) of the precipitation that falls on Nebraska comes in the six warm months of the year (April-September) and originates in warm, moist air from the Gulf of Mexico. However, much air moving north from the Gulf is deflected to the east by the eastward movement of air over the Rockies, with the result that the easternmost part of the state receives more than twice as much precipitation as the westernmost part, and much Gulf air that originates at the longitude of Nebraska misses the state altogether.

Average annual precipitation decreases rather uniformly from more than 34 inches in the southeast (34.51 at Falls City, 1931-1955) to about 13 inches in the western part of the Panhandle (12.88 at Mitchell, 1931-1955). Thundershowers in spring and summer account for a large part of the rainfall. In some years thundershowers are numerous and well distributed but more often than not they are infrequent and scattered. The result is a great variability in monthly or annual (or both) rainfall from year to year. A few hailstorms are recorded each year in Nebraska, mostly in June, July, and August. Snowfall generally is heavier in the east, north, and northwest than in the central and southwestern parts of the state and averages about 29 inches annually.

Precipitation at Nebraskan weather stations was officially recorded as early as 1876 and since that time a succession of wet and dry periods have occurred as follows (Blair, 1941; Stevens, 1959):

1876-1892. Wet period with one dry year.
1893-1901. Dry period with one rather wet year.
1902-1909. Wet period with one rather dry year.
1910-1920. Irregular precipitation; most years dry, but 1915 wettest year on record.
1921-1940. Dry period with one wet year; especially dry after 1930.
1941-1951. Wet period with one dry year.
1952-present. Moderately dry period.

Mean annual temperature varies from between 53° and 54° F. along the southern border of Nebraska (54.0 at Pawnee City, 53.7 at Fairbury, 53.6 at Beaver city, and 53.3 at Benkelman, all 1931-1955 averages) to 45.8° F. (1931-1955) at Harrison in the northwestern corner of the state. Maximal summer temperatures in excess of 100° F. occur regularly throughout the state in June, July, August, and September, 118° F. recorded at Geneva, Hartington, and Minden being the record high. Minimal temperatures of 0° F.

or colder occur on the average in 10 days of the year in the southeast and in 25 days in the northwest. Minima lower than — 40° F. have been recorded on several occasions; the record low for the state is — 47° F., recorded at Camp Clarke on February 12, 1899. The average date of the last freeze in spring ranges from April 25 in the extreme southeast to May 21 in the northwestern part of the Panhandle, and the average date of the first freeze of autumn from about October 6 to September 20 in the same areas. The growing season, therefore, ranges on the average from 164 days in the southeast to 122 days in the northwest, but is subject to considerable variation from year to year. The relative humidity varies on the average from about 60 per cent in the warm months to 70 per cent in the colder parts of the year.

SOILS

Three of the major soil divisions of North America are found in Nebraska in the form of six general soil associations. Three of the associations, brunizem, chernozem, and chestnut, are among the dark-colored soils that developed under prairie vegetation; two, regosol and lithosol, are immature, shallow soils; the sixth, alluvium, is a soil of stream bottomlands (see especially "Soils of the north central region of the United States," Bull. Univ. Wisconsin Agric. Exp. Sta., 554:1-192, illustrated, June, 1960).

Each of the soil associations needs to be thought of in relation to climate, vegetation, physiography, and geologic history, because all influenced soil formation.

Brunizem.—This soil association owes its existence to tall-grass prairie. Brunizem (or prairie) soils developed under tall grass in a temperate, relatively humid climate, and occupy an extensive area in the central United States that now corresponds closely to the so-called "corn belt." Brunizem soils generally form a dark grayish brown, thick, slightly acid upper horizon that is underlain by dark yellowish brown or grayish brown subsoils. Brunizems can form from materials that vary from sand to clay (but form mostly from loess, glacial outwash or glacial till) and are among the most agriculturally productive soils known.

Humic-gley soils, known also as wet meadow soils, are found extensively throughout this soil association. Humic-gley forms under grasses and sedges on sites that are poorly drained but not wet enough to support formation of organic soils, is thick, blackish, usually non-calcareous, and is underlain by grayish subsoils.

Chernozem.—Chernozem covers the loess plains of eastern and central Nebraska; it developed under the drier, western part of the tall-grass prairie and adjacent parts of the mixed prairie. The color is grayish brown, paler than brunizem, the amount of water moving downward is less than in brunizem, and the upper horizon is slightly acidic to mildly alkaline.

Chernozem soils occupy well-drained sites, the gentle slopes and rolling hills, of the loess plains and intergrade on steep slopes with regosols and in swales and lowlands with planosols.

Chestnut.—Soils of this association are present on the High Plains of western Nebraska and in adjacent regions. Chestnut soils are associated with mixed-grass prairie. They grade westwardly into the brown soils of the disclimax short-grass prairie, are characteristic of semi-arid areas (less than 20 inches of annual precipitation), brownish, and relatively thin. This soil association borders the Sand Hills on the west and south, and south of the Platte River in central Nebraska grades eastward into the darker chernozem.

Small areas of immature, shallow soils are completely surrounded by elements of the chestnut soil zone in the Panhandle, including the lithosols of the rough, broken lands of the Pine Ridge and of the hills and breaks along the North Platte River, and some isolated areas of Valentine sand (a regosol). Also of especial note are the Badlands to the north of the Pine Ridge escarpment in Dawes and Sioux counties. This rugged section, mostly Pierre Shale of Cretaceous age and a part of the Missouri Plateau, has clayey shales (gumbo) exposed over wide areas along with some lithosols on the more rugged slopes.

Regosol.—This soil association in Nebraska is composed entirely of sands and fine sandy loams of the Valentine series. It is mostly confined to the Sand Hills proper, north of the Platte River in the central part of the state, but occurs also in isolated patches along the Platte farther to the east, south of the Platte in the southwest, and on the High Plains. The Valentine sands are composed mostly of the coarser materials of the Tertiary peneplain that once covered much of central and western Nebraska and were developed through eolian action. In addition to sand, some humic-gley soil is found in the Sand Hills around the many lakes and marshes.

Lithosol.—Lithosols are thin, immature soils that develop over rock. No true subsoil is present. In Nebraska, lithosols occur on the Pine Ridge and in the rough country along the North Platte River in the western Panhandle.

Alluvium.—This soil association is found in Nebraska in the bottomlands of the larger rivers and their major tributaries. It is a poorly defined association because it frequently combines elements from two or more other soil associations. In the western part of the state, alluvial soils tend to be darker and more humic than soils of adjacent uplands and frequently support a riparian plant community notably different from that of uplands.

The soils of the general associations described above are divisible into soil series, which themselves may be subdivided into soil types. For detailed information of this sort, the reader is directed to the soil surveys of individual counties that, beginning in 1913, have been issued by the U. S. Department of Agriculture for all but six (Arthur, Grant, Hooker, Logan, McPherson, and Thomas) of Nebraska's 93 counties. Reference to these surveys and especially their accompanying maps is useful in the selection of collecting sites for mammals and may be useful also in locating place names that do not appear on maps of larger scale.

Some relationships of soils to distribution and speciation of mammals in Nebraska are discussed in a following chapter.

Geology and Physiography

Geology

"The geological formations of Nebraska occur as (1) unconsolidated sediments called mantelrock, shaped by wind, streams and glaciers, (2) widespread sedimentary bedrock known as shale, mudstone, sand, sandstone, and limestone, and (3) deep-seated granite and granite-like rocks. Much of the state is mantled with rock debris beneath which bedrock outcrops in places" (Condra and Reed, 1943:1). The mantle is mostly of Pleistocene age and the bedrock ranges in age from early Paleozoic to late Tertiary—see Condra and Reed, *op. cit.:* figs. 1 and 3, for maps showing location and extent of mantlerock and bedrock in Nebraska.

The Quaternary mantle, frequently 100 to 300 feet thick, consists mostly of the dune sand of the Sand Hills and some small, isolated areas adjacent thereto, and loess, deposits of which cover that part of Nebraska situated to the east and south of the Sand Hills (the Loess Plains, Loess Hills, and Loess on Glacial Drift areas of some topographic classifications). West of the Sand Hills, on the High Plains, the mantle, partly loess, is thin or absent.

Bedrock outcrops in Nebraska principally in the southeast (Mesozoic and Paleozoic rocks) and in the Panhandle (Tertiary rocks

and Pierre Shale of Cretaceous age). Outcroppings of pre-Tertiary rocks in the southeast and elsewhere usually are thinly exposed, generally along water courses, but the Tertiary rocks of western Nebraska (Pliocene, Miocene and Oligocene) are exposed over wide areas and provide important habitats for some mammals.

Hydrography

The surface drainage of Nebraska falls entirely within the Missouri River system and direction of drainage, therefore, is generally eastward to the Missouri, which forms the eastern border of the state. Excepting the immediate vicinity of the Missouri itself, Nebraska has eight major drainage basins. North of the Pine Ridge in the northwest, the Hat Creek and White River basins drain northwardly into South Dakota. The Niobrara River, flowing eastward the entire length of the state, drains all but a small part of northern Nebraska and empties into the Missouri in Knox County. The Platte River also courses the breadth of Nebraska, through the central part of the state, its basin receiving the southeastward-flowing Loup River (in Platte County) and Elkhorn River (in Sarpy County); the Platte is the longest of the Missouri's tributaries. In southern Nebraska, the Republican and Blue basins drain away to the southeast, eventually to reach the Missouri via the Kansas River system. Much of the water in Nebraska's streams and rivers comes from surface run-off, but a significant portion comes from underground sources, especially from the area under the Sand Hills.

Aside from streams and rivers, Nebraska has about 2500 lakes, marshes and artificial reservoirs containing 15 acres or more of water. Most of the natural lakes and marshes are in the Sand Hills where, counting bodies of standing water of all sizes, the number exceeds 3000.

Physiography

According to Frye and Schoewe (1953:246), the "problem of defining 'physiographic subdivisions' is a difficult one in any region, and particularly so where the region to be so subdivided is a plains country." They went on to point out (p. 247) that "all aspects of the flora, fauna, climate, soil, geology, and topography should be considered in erecting a physiographic unit and each such unit should possess some degree of internal homogeneity." With this definition in mind, and using Fenneman (1931) as a starting point, the general physiographic regions of Nebraska can be defined as follows:

Central Lowlands Province

This province includes approximately the eastern fourth of Nebraska—all within Fenneman's Dissected Till Plains section. The border between the Central Lowlands and the adjoining Great Plains, marked by a series of low hills or an eastward-facing escarpment in other places, is poorly defined in Nebraska because the original border is buried under loess. The boundary in Nebraska is taken to be the westernmost extension of glacial (Kansan) till. The Central Lowlands Province occupies roughly the same area in Nebraska as does the tall-grass prairie and the brunizem soil group, and includes as districts the Drift-Loess Hills in the northeast, Loess Hills south of the Platte River in the southeast, and the Missouri River Lowlands.

Great Plains Province

The western three-fourths of the state falls within this province; three different sections, the Plains Border, High Plains, and Missouri Plateau, are recognized, each having well-marked districts.

Missouri Plateau Section.—This section is found in two disjunct areas in the northern part of the state. In the northwest, the Pierre Plains (including the Badlands) to the north of the Pine Ridge form one distinct unit, and the Niobrara District, including the unglaciated tablelands and plains to the northeast of the Sand Hills in Boyd, Keya Paha, and parts of Antelope, Brown, Cherry, Holt, Knox, and Rock counties, forms a second. Whereas the boundary of the Pierre Plains is well marked by the Pine Ridge, the Niobrara District merges gradually with the Sand Hills to the southwest and with the Drift-Loess Hills of the Central Lowlands to the east.

Plains Border Section.—The Plains Border includes the central part of the state south of the Sand Hills. Mantled with loess or sandy loess, it grades into the Central Lowlands eastwardly, the High Plains westwardly, and the Sand Hills northwardly. The boundary with the High Plains is marked in several places by isolated areas of dune sands that are here regarded as belonging to the Plains Border. Two distinct units of this section, divided by the Platte River, are recognized, the Loess Hills and Plains to the north and the Loess Plains to the south.

High Plains Section.—Being the most diverse of the sections of the Great Plains in Nebraska, the High Plains includes the following districts: Sand Hills, including approximately 18,000 square miles

of dune sands of precisely the same area described in relation to soils and vegetation; Pine Ridge, a rugged, pine-covered escarpment in the northwest that separates the High Plains from the Missouri Plateau; the High Plains proper (Western Nebraska-Eastern Wyoming Upland of Fenneman), including the tablelands both north and south of the North Platte River in the Panhandle and the rough, broken country along (and south of) that river in Banner, Morrill, and Scotts Bluff counties; and the deeply eroded Goshen Hole Lowland, which encompasses the western part of the North Platte Valley.

The "topographic regions" of Nebraska, more precisely defined and limited than the physiographic areas recognized here, have been mapped previously by Condra (1934:2) and Lugn (1935:16).

VEGETATION

The vegetation of Nebraska probably is better known than that of any other plains state, as illustrated by the following selected references: Rydberg (1895); Pound and Clements (1900); Pool (1914 and 1957); Aikman (1929); Winter (1936); Weaver (1954); Weaver and Albertson (1956).

Pound and Clements (*op. cit.*), in their "The Phytogeography of Nebraska," were first to propose a system of vegetative zonation for the state, wherein they recognized four major "regions" as follows: *Wooded Bluff and Meadow Land* (confined to the extreme eastern part of the state); *Prairie* (tall-grass prairie); *Sand-hill* (including Sand Hills proper and adjacent areas of mixed-grass prairie to the south of the Platte River; and *Foot-hill* (High Plains, Pine Ridge, and adjacent areas of the Panhandle). Each region was subdivided into two or more "districts." In addition, nine "general classes or formations" of plant life were proposed, not necessarily limited to a particular region or district. This work, despite the short-comings resulting from its appearance at a time when the science of plant geography was in its infancy, remains the basic reference on Nebraskan phytogeography.

Pool (1914: frontispiece) recognized six "phytogeographic regions" in the state as follows: Broadleaf Woods; Yellow Pine; Prairie; Short Grass; Sandhills; and Badlands. Inasmuch as Pool's study dealt only with the Sand Hills, there was no elaboration in text concerning his arrangement.

Utilizing the two works last cited, supplemented by additional published information (see among others Braun, 1950; Kellogg, 1905; Weaver, 1954; Weaver and Albertson, 1956), the vegetation

of Nebraska can be divided into two basic segments, forest and grassland, the former having two major associations and the latter three.

Forests

Deciduous Forest.—The deciduous forest of this classification is restricted to the oak-hickory association (Braun, 1950:181-184) occurring along the Missouri River and its major tributaries in the southeastern part of the state. The northern limit is reached along the Missouri approximately at the southern border of Washington County, although some species of trees characteristic of this assemblage extend no farther northward than the mouth of the Platte, if that far. On the other hand, several important species (red oak, bur oak, and basswood, for example) occur much farther northward or westward than the boundary of the association as here delimited. Unfortunately, much of the oak-hickory woodland that once occurred in southeastern Nebraska has been destroyed by man.

Aikman (1927) recognized three major communities in the deciduous woodlands of eastern Nebraska, bur oak-bitternut hickory, black oak-shellbark hickory, and red oak-basswood; the first two are limited to the oak-hickory association. About 43 species of deciduous trees are native to southeastern Nebraska (see Pool, 1957), of which 20 are more or less restricted to the oak-hickory association. Characteristic trees of this area are as follows (those marked by an asterisk do not occur elsewhere in the state):

Black Walnut (*Juglans nigra*)
* Bitternut Hickory (*Carya cordiformis*)
* Shellbark Hickory (*Carya ovata*)
Hop-hornbean (*Ostrya virginiana*)
Red Oak (*Quercus borealis* var. *maxima*)
* Black Oak (*Quercus velutina*)
Bur Oak (*Quercus macrocarpa*)
* Yellow Oak (*Quercus muehlenbergii*)
Red Elm (*Ulmus rubra*)
Kentucky Coffee Tree (*Gymnocladus dioica*)
Silver Maple (*Acer saccharinum*)
Basswood (*Tilia americana*)

Eastern deciduous trees occur, of course, far to the west in Nebraska (mostly along rivers) of the limits of the oak-hickory association, but the deciduous flora becomes increasingly depauperate in number of species westwardly, until only a few kinds (several willows, cottonwood, ash, boxelder, American elm) remain. These dendritic extensions of deciduous vegetation into grasslands are

properly regarded as communities of the major plant association in which they occur.

Coniferous Forest.—As here understood, the coniferous forest association now is limited to the slopes of the Pine Ridge of the northwestern part of the state and to smaller, less densely forested areas on the Bighorn and Wildcat ridges to the south of the North Platte River in Banner and Scotts Bluff counties. Although these two areas have no connection in Nebraska, they are connected farther to the west in Wyoming according to R. Kellogg (1905:12). The only dominant is western yellow pine (*Pinus ponderosa*); in fact, only one other native conifer, western red cedar (*Juniperus scopulorum*), occurs in the two areas and it is not limited thereto.

The yellow pine occurs in Nebraska also in some places along the Niobrara River as far east as Keya Paha County, and within historic time occurred in several isolated areas in other parts of central and western Nebraska (see Kellogg, *loc. cit.*, and Pool, 1957:172, map 1). The species probably occurred widely over much of the western part of the state in post-Wisconsin times and the areas remaining when white man first reached western Nebraska were relics of this former widespread distribution.

The montane floral affinities of the Pine Ridge are strengthened by the occurrence there, in addition to yellow pine, of quaking aspen (*Populus tremuloides*), narrow-leaved cottonwood (*P. angustifolia*), balsam poplar (*P. balsamifera*), and western black birch (*Betula fontinalis*). Only one of these four species (narrow-leaved cottonwood) occurs also in Banner and Scotts Bluff counties but Rydberg's cottonwood (*P. acuminata*), a western species which does occur there, is lacking in the Pine Ridge area.

Grasslands

Tall-grass Prairie.—The tall-grass prairie, or true prairie as it often is called, originally occupied the vast region of the central United States that lies between the deciduous woodlands and the mixed prairie of the Great Plains. In Nebraska, typical tall-grass prairie covered that part of the state east of approximately the 99th meridian, excepting the area occupied by deciduous forest. "The transition zone from the true to the mixed prarie is very gradual and the corresponding ecotone unusually broad. The best limit is set by the disappearance of *Stipa spartea* [needlegrass] and *Sporobolus asper* [tall dropseed], which are replaced in the mixed prairie by very closely related species, *S. comata* and *S. cryptandrus*. In

Nebraska the relation is further disturbed by the extensive sand-hill region, in which the high chresard favors a postclimax of tall grasses far beyond their proper climate" (Weaver and Clements, 1938:524). The ecotonal area between tall grass and mixed grass was displaced eastward 100 to 150 miles in Nebraska as a result of the "great drought" (1933-1941) according to Weaver and Bruner (1954:122).

Tall-grass prairie grows mostly on brunizem soil, but the western part of the region in Nebraska is on chernozem soil. The western border of tall grass approximates the line of 23 inches of annual precipitation. Most of the original tall-grass prairie in Nebraska (and elsewhere) has been turned for agricultural purposes; only small, mostly isolated areas remain.

Weaver (1954), whose "North American Prairie" is recommended to the reader, recognized six plant communities of the tall-grass prairie (dominated by 10 grasses). Lowland communities noted were: big bluestem (*Andropogon gerardi* and the introduced bluegrass, *Poa pratensis*); sloughgrass (*Spartina pectinata*); and switchgrass (*Panicum virgatum*)—Canada wild-rye (*Elymus canadensis*). Communities of uplands listed were: little bluestem (*A. scoparius* along with side-oats grama, *Bouteloua curtipendula,* and Junegrass, *Koeleria cristata*); needlegrass (*Stipa spartea*); and prairie dropseed (*Sporobolus heterolepis*).

Mixed Prairie.—The mixed prairie covers the largest area of any of the grassland associations of North America; it is the grassland of the Great Plains. This association owes its name to the fact that its climax vegetation is comprised both of mid grasses and short grasses, on more or less equal terms (Weaver and Clements, 1938:523). In Nebraska, the mixed prairie is underlain by chernozem and chestnut soils, and originally covered that part of the western two-thirds of the state not included within the Sand Hills. The so-called short grass plains of western Nebraska and adjacent regions, once thought a distinct grassland association, now are known to represent only a disclimax of the mixed prairie, resulting primarily from overgrazing (Weaver and Clements, *loc. cit.*).

Major dominants among grasses in mixed prairie are: needle-and-thread (*Stipa comata*); western wheatgrass (*Agropyron smithii*); sand dropseed (*Sporobolus cryptandrus*); Junegrass (*Koeleria cristata*); buffalo grass (*Buchloe dactyloides*); and blue grama (*Bouteloua gracilis*). In the short-grass disclimax, blue grama, buffalo grass, and cactus (*Opuntia*) prevail; sages (especially *Artemisia tridentata*) are not uncommon in some areas.

Significant areas of mixed-grass prairie remain in Nebraska, albeit frequently overgrazed by cattle, but some parts have been converted to croplands.

Sand Hills.—The vegetation of the Sand Hills is a combination of tall grasses, mid grasses, and species dominant on sandy soils. The result is a vegetative assemblage so unique that it deserves separate treatment among the grassland types of Nebraska. The high water table of the Sand Hills favors a postclimax segment of tall grasses in the many meadows and around the many lakes; three different plant communities occur on uplands (Weaver and Albertson, 1956). In addition to overgrazing, drought and fire, which affect drastically the conditions in all grassland areas, windblown sand is a major factor affecting plant cover on the Sand Hills. For botanical studies concerning this interesting area, the reader is directed to Rydberg (1895), Pool (1914), Tolstead (1942), and Weaver and Albertson (*op. cit.*:163-192).

According to Weaver and Albertson (*loc. cit.*), plant communities of the Sand Hills (and dominant species) are: blowout (blowout grass, *Redfieldia flexuosa,* and a legume, *Psoralea lanceolata*), which becomes established first at the bottoms or on the lower slopes of barren blowouts after sand stops shifting there; sandhill muhly (*Muhlenbergia pungens*), which occurs on upland areas of relatively stable dune sands; bunch grass (little bluestem, sand bluestem, *A. hallii,* sand reed, *Calamovilfa longifolia,* needle-and-thread, and frequently soapweed, *Yucca glauca*), the widespread, characteristic upland vegetation of the Sand Hills; and the lake and wet meadows, in which a transition occurs from numerous sedges and certain tall forbs in the wettest places through a distinctive middle zone (big bluestem, sloughgrass, switchgrass, and other species) to the upper portion of wet meadows where postclimax true prairie obtains (little bluestem, tall dropseed, Junegrass, and western wheatgrass).

It is well to note that deciduous trees occur in the Sand Hills along the major streams, and ponderosa pine is found at certain places along the Niobrara and some of its tributaries. The grassland of the Sand Hills is devoted almost exclusively to grazing of livestock.

Effects of Man on the Environment

Since the settlement of Nebraska by European man, principally in the last century, he has changed tremendously the pristine environment. Changes wrought by man have been detrimental to

some mammalian species and advantageous to others. Directly, man extirpated some large ungulates and carnivores and drastically reduced populations of some other species. Indirectly, for example by cutting timber, turning prairie sod, and diverting or polluting streams, he endangered, at least in some areas, survival of other mammals. On the other hand, man controlled prairie fires that long had restricted woodlands, planted trees where none had grown previously, created artificial bodies of water that soon acquired riparian plant communities, brought food (cultivated grains) to areas where food previously had been scarce, and even introduced some mammals at places where they had not occurred naturally. In the accounts of species beyond, I have attempted, where appropriate, to mention specific effects resulting from the activities of man.

For an account of Nebraska as the white man found it, and some of the changes that followed his emigration, the reader is directed to R. H. Wolcott's "Biological conditions in Nebraska" (Proc. Nebraska Acad. Sci., 8(2):23-34, 1906).

FACTORS INFLUENCING DISTRIBUTION AND SPECIATION

Wisconsin Glaciation and Post-Wisconsin Climates

The Pleistocene Epoch, comprising four, vast continental glaciers (Nebraskan, Kansan, Illinoian, and Wisconsin), each followed by a comparatively warm, dry period (Aftonian, Yarmouth, Sangamon, and Recent), obviously affected markedly the distribution and speciation of organisms in boreal and temperate regions. Although details of the distribution of some species in the Pleistocene are conjectural, it is known that biotic assemblages were displaced, not necessarily intact, southward on the North American continent ahead of advancing glaciers, and that they shifted northward again, probably beyond their limits as we now know them, in interglacial times. Important as these massive shifts in response to changing climates may have been in the speciational and distributional histories of the elements of boreal and temperate biotas, it is necessary to look no farther back than the last continental glacier (Wisconsin) and subsequent post-glacial events for an explanation of the composition of the Recent mammalian fauna of Nebraska.

At its maximum, some 18,000 years BP (before the present), the edge of the Wisconsin glacier rested nearest Nebraska immediately north of the Missouri River in extreme southeastern South Dakota

as evidenced by accumulation there of drift deposits (Flint, 1957: 338, fig. 20-1), but according to Schultz *et al.* (1951:6) actually did reach what is now the northeastern edge of Nebraska. From southeastern South Dakota, the glacial border generally extended northwestward toward North Dakota, roughly paralleling the present course of the Missouri, and east-southeastward across northern Iowa. At the same time, isolated but relatively extensive montane glaciers, the so-called Cordilleran glaciers, rested on the Rocky Mountains to the west.

Exactly what the conditions at the latitude of Nebraska were at the time of maximal extent of the Wisconsin and Cordilleran glaciers is unknown, but most authorities (Clements and Chaney, 1937, Deevey, 1949, Dillon, 1956, Dorf, 1959, Martin, 1959, for example) agree that the climate was cooler than now, and that general biotic assemblages characteristic today of more northerly areas prevailed in at least some regions. Dillon (*op. cit.*) attempted to reconstruct Wisconsin climates and life-zones, and suggested that the mean maximum temperature under which a continental glacier could continue to grow was 45° F.; therefore he postulated (p. 167) a depression of 25° F. (as compared with temperatures in the same areas today) in mean annual temperature at the edge of the ice sheet decreasing to a drop of about 5° F. at the Equator. With this as a guide, he suggested (p. 174, fig. 10) that conditions in Nebraska at the height of the Wisconsin approximated those of the present-day Arctic, Hudsonian and Canadian life-zones, all of which now occur far to the north and west of the state.

Cold-adapted animals and plants certainly occurred to the south of the glaciated region in Wisconsin times. Among mammals, caribou in Nebraska (Schultz *et al.*, 1951: table 1), Iowa and New Mexico (Banfield, 1962:40), the collared lemming and heather vole in Pennsylvania (Guilday and Doutt, 1961:249), the masked shrew (Findley, 1953:645) and southern bog lemming (Jakway, 1958:321) in Nuevo León, México, and the masked shrew, Richardson's ground squirrel and meadow vole in southwestern Kansas (Hibbard, 1949:86) attest to this, as do relict populations of montane species on the Black Hills of South Dakota and elsewhere on the Great Plains. At or about the same time warmth-adapted species (Blair, 1959) were displaced southward to refugia in peninsular Florida and eastern México. Elements of the boreal forest, too, occurred far south of the glacial boundary (Blair, *op. cit.*, Deevey, 1949, and others), but in some instances northern floral elements may

have existed as isolated, marginal stands amid otherwise temperate floras; in the Rocky Mountains, coniferous forest existed at much lower elevations than now. In the Plains region, hemlock and other conifers grew near the glacial border in Iowa and South Dakota (Flint, 1957:323). Further, according to Clements and Chaney (1937:24): "There is good evidence from relict trees that the boreal forest of climax conifers and subclimax hardwoods moved southward over the Great Plains in front of the ice, since the white spruce persists today in the higher parts of the Black Hills of South Dakota, and the aspen and paper birch survive in northern Nebraska . . . ." Also, the occurrence of ponderosa pine at scattered localities in Nebraska as far south as the Kansas border (Pool, 1957:172, map 1) when white man first reached the state suggests a more widespread and continuous distribution of that species in past times.

On the other side of the ledger, Braun (1950 and elsewhere), Kendeigh (1961) and others have argued for relatively little change, vegetationally at least, to the south of the glacial boundaries. Kendeigh (p. 286) reviewed the evidence supporting four separate refugia (rather than widespread southward displacement) for the boreal forest, and suggested (p. 287) that the Floridian and Mexican refugia for many vertebrates owed existence not to colder climate but to the southward extension of relatively dry grassland to the Gulf of Mexico. He noted also (p. 286) that the formation of loess on the Great Plains (both Peorian and Bignell loess formed in Wisconsin times) was indicative of the then existing vegetation: "This buff-colored, homogeneous, porous, calcareous, non-stratified deposit forms only in arid or semi-arid regions, and is indicative of grassland abutting directly on the glacial front. There is no evidence that extensive coniferous forest existed in front of the glacier during any of its advances in this area." Schultz *et al.* (1951:28) suggested also that the formation of loess indicated a time of "desiccation" and "reduced vegetative covering." Insofar as mammals are concerned, the presence in Nebraska in Wisconsin times (Schultz *et al.*, 1951:table 1) of grassland types such as ground squirrels, prairie dogs, two genera of pocket gophers, pocket mice, two kinds of lagomorphs, and pronghorn, along with extinct horses and bison, strongly suggests a prairie-plains environment, at least in part.

Unfortunately, few Wisconsin faunal and floral assembledges have yet been discovered near the glacial border on the Great

Plains; perhaps few will be found. Until such time as more complete evidence is available, no conclusive statement can be made concerning character of the biota in Wisconsin times. It is well to remember also that the period of "maximal" extent of the ice sheet, covered perhaps 10,000 years or more, and produced several regionally important retreats and readvances of ice (substages and interstadial periods) that may have affected profoundly local conditions near the southern boundary of the glacier. In other words, minor shifts in the climate and in the biota can be inferred as having taken place in this period.

On the basis of the evidence presently available, it seems reasonable to postulate that a kind of azonal, ecotonal plant and animal community existed in Nebraska at the height of Wisconsin glaciation. Where conditions of slope, soil and drainage permitted, conifers and other boreal species prevailed; in river valleys and other favored areas, especially in the eastern part, elements of the eastern deciduous forest may have occurred; and grassland occupied still other areas. Perhaps the landscape had a parklike appearance as do some present-day areas on the western slopes of the Rocky Mountains. The climate probably averaged somewhat cooler than now. The mammalian fauna may have been a mixture of boreal species and relatively cold-tolerant temperate species—especially wide-ranging kinds and those of grassland affinities—that were distributed ecologically in accordance with local conditions at any one time and place. Such an hypothesis is generally in accord with the ideas advanced by Smith (1957:207), who wrote: "No definite evidence is contributed by the distributional patterns of terrestrial vertebrates as to what the biota to the south of the Wisconsin glacier may have been, and a compromise on the extent of biological displacement seems advisable. This intermediate viewpoint recognizes that the fauna of the glaciated territory was forced southward or eliminated but does not imply that the boreal fauna completely replaced a more southern faunal type or that the area south of the ice front was appreciably colder than at present. This view holds that an admixture of ecologically segregated boreal and austral elements existed, possibly almost side by side, near the ice front but within unglaciated territory."

With the foregoing as a background, we can discuss some biotic changes that may have occurred in the post-Wisconsin era. After maximal advance of the glacier, there followed the "late-glacial period," a time of stagnation, retreat, and periodic readvance of

the ice, culminating with the Valders readvance about 10,700 years BP. It is reasonable to envision a general withdrawal from the Nebraskan region of some boreal elements, accompanied by invasion of an increasing number of temperate species in those times. Subseqeunt to the Valders, which advanced no nearer than 500 miles to what is now Nebraska, there ensued a series of post-glacial climatic shifts, usually reckoned as within Recent time, that played a major role in influencing the composition of the modern mammalian fauna of the state. The major climatic periods of the post-Wisconsin in North America, which are correlated with known climates of the same stages in Europe, have been the subject of a number of recent papers (see especially Deevey, 1949, Deevey, 1961, Deevey and Flint, 1957, Martin, 1959, Martin *et al.*, 1961, Sears, 1961, Smith, 1957). From several sources, the approximate chronology of events since maximal Wisconsin glaciation is as follows:

17,000-18,000 BP	Maximal advance of Wisconsin ice sheet
11,000-17,000 BP	Stagnation, retreat, and periodic readvance of ice
10,000-11,000 BP	Valders readvance
9,000-10,000 BP	Post-Valders phase
2,500- 9,000 BP	Hypsithermal Interval
4,000- 9,000 BP	Warm, wet (Climatic Optimum)
2,500- 4,000 BP	Warm, dry (Xerothermic Period)
After 2,500 BP	Sub-Atlantic or Recent phase

In pre-hypsithermal time, after the Valders readvance, climate of the central grasslands may have approximated that of the region today. At such a time, invasion by temperate species would have been accelerated and some remaining boreal elements excluded, but the more tolerant boreal kinds probably remained relatively widespread, some more or less continuously distributed and others in scattered relict areas. One faunal assemblage from this period (Schultz and Frankforter, 1948), from three sites associated with remains of early man in Frontier County and having an average C-14 date of 9,524 BP, yielded the following mammals (specific determinations not given): *Blarina; Lepus; Sylvilagus; Cynomys;* geomyid; *Perognathus; Castor; Peromyscus; Synaptomys; Microtus; Canis; Procyon; Taxidea; Odocoileus;* large cervid; *Antilocapra; Bison.* Considering the time factor, I assume that these remains are, at least in the majority of instances, referable to Recent species. Most are wide-ranging or grassland kinds, but *Synaptomys* and possibly the *Microtus* (identification to species needed) are boreal elements, and *Blarina* is an animal of the eastern deciduous forests,

reflecting a westward extension of that faunal and floral assemblage in the Post-Valders phase.

Hypsithermal Interval

With the advent of the warmer, relatively moist Climatic Optimum (9,000-4,000 BP) of the Hypsithermal Interval, I imagine a westward extension far onto the plains of elements of the eastern deciduous forest and probably also tall-grass prairie—forest species along the river systems and on favored drier sites, and tall grasses on the uplands. Climatic conditions at this time would not have been unfavorable for the hardier boreal elements still remaining, and such trees as ponderosa pine (*Pinus ponderosa*) and such mammals as *Microtus pennsylvanicus, Sorex cinereus* and *Synaptomys cooperi* probably occurred in relatively undisturbed, albeit possibly disjunct, areas. Sears' (1961:2038-2039) report of a pollen profile from Hackberry Lake, Cherry County, bears on the point. In sediments from the lake bottom having a C-14 date of 5040 ± 95 years BP, he found a "minimum of grass and maximum of forest." Subsequently, trees became few and grasses abundant for a time, corresponding roughly to the Xerothermic Period, but in relatively recent time (after 1110 ± 75 years BP) trees increased in abundance at the expense of grasses. In the sediments dated 5040 ± 95 years, Sears found roughly 25 per cent of the pollen to be that of trees, which he interpreted as indicative of a "humid interlude," but more than half of the tree pollen was pine, which he interpreted as possibly indicating that the period was cool, not warm. A different explanation occurs to me for the relatively large amount of pine pollen, namely that many of the hardier boreal animals and plants that remained after glaciation survived most or all of the Climatic Optimum, only to be eliminated or reduced to relict status in the following hot, dry Xerothermic Period.

Smith (1957) analyzed the post-Wisconsin biogeography of the Prairie Peninsula and noted evidence from recent distributional patterns that four species of amphibians and five of reptiles having southern affinities dispersed northward well beyond the limits of their presently continuous ranges during the Climatic Optimum. An undated occurrence of the rice rat (*Oryzomys palustris*) in Indian mounds near Peoria, Illinois (Smith, *loc. cit.*), far north of the present range of the species, may reflect a northward shift of *O. palustris* in the warmer, wetter period of the Hypsithermal, and the specimen said to have been taken at Neosho Falls, Kansas,

in 1859 (Cockrum, 1952:281) could represent a relict population, now extirpated, resulting from the same northward dispersal.

On the plains, evidence of dispersal of mammals in the Climatic Optimum is scanty but the present distribution of at least two species is instructive. The white-footed mouse, *Peromyscus leucopus,* typically an inhabitant of deciduous woodlands in the northern part of its range, presently occurs in a number of scattered, relatively or actually isolated localities (where stands of deciduous timber also are isolated) on the Great Plains from northwestern Nebraska to southeastern Alberta. If these relict populations had resulted from dispersal in the wake of the retreating Wisconsin ice sheet, it would be expected that *P. leucopus* now would have a more northerly distribution in the plains region. The only logical explanation, therefore, is that the species dispersed northwestward along river systems in company with deciduous timber during the Climatic Optimum. The following Xerothermic Period destroyed the continuous dendritic extensions of eastern woodland but left isolated patches in certain favored areas, in some of which white-footed mice also survived. Relict populations of the meadow jumping mouse, *Zapus hudsonius,* in the same region, on the other hand, most likely date not from the Climatic Optimum but from the time following glacial retreat.

The second species, *Neotoma floridana,* has a relict population (*N. f. baileyi*) in northern Nebraska that apparently is restricted to the relatively cool canyons of the Niobrara River and a few of its tributaries. This woodrat could have reached this area only at a time when deciduous woodlands were more extensive, both geographically and in number of species, than now—in other words, during the Climatic Optimum. The ensuing Xerothermic Period excluded this rat from other parts of northern and eastern Nebraska that formerly were occupied, leaving the relict subspecies, *baileyi,* stranded along the Niobrara (see Fig. 1). Presumably the relict distribution of the cork elm (*Ulmus Thomasi*) in the same area supports this explanation. The more westerly distribution of another subspecies of *N. floridana* (*N. f. campestris*), which occurs today in southwestern Nebraska and adjacent parts of Colorado and Kansas, is more difficult to explain; the distribution of *campestris* is spotty and irregular throughout its range and a few small populations that were isolated in xeric times may have dispersed since then to a greater or lesser degree.

It can be postulated that other species having eastern and southern affinities spread also to Nebraska in the Climatic Optimum

and, finding no suitable refugia in the warm, dry part of the Hypsithermal Interval, were subsequently excluded—but no additional evidence of such dispersal is available.

In Xerothermic time (4,000-2,500 BP) the climate was considerably more arid than now. In this period, the much-discussed

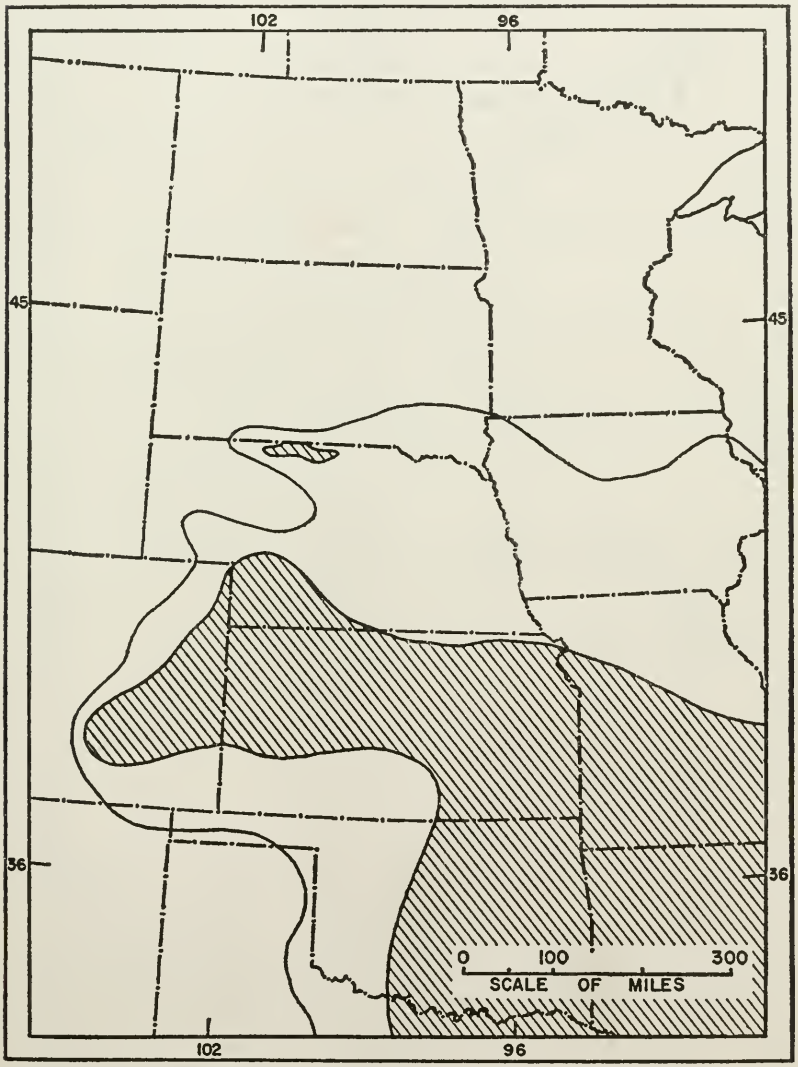

FIG. 1. Present distribution of *Neotoma floridana* in the region of Nebraska (diagonal lines) and postulated extent of distribution in the Climatic Optimum (outer black line).

Prairie Peninsula extended eastward to the region south of the Great Lakes, affording entry to that area for many prairie species (see Smith, 1957)—among the mammals, for example, the plains pocket gopher, *Geomys bursarius,* and two ground squirrels, (*Spermophilus franklinii* and *S. tridecemlineatus*). The prairie subspecies of the spotted skunk (*Spilogale putorius interrupta*), now restricted to the western side of the Mississippi River, ranged across the Mississippi as evidenced by remains found in an Indian rock shelter in Illinois (Parmalee and Hoffmeister, 1957:261). As previously noted, the Xerothermic Period seemingly had a marked effect on the distribution of at least some mammals of eastern and southern affinities that had spread westward during the Climatic Optimum. Another probable effect concerns the present distribution of the short-tailed shrew, *Blarina brevicauda.* This eastern species early invaded the plains region as noted by remains found in association with early man in southwestern Nebraska in sites dated prior to 9,000 BP. In the warm, wet interlude of the Hypsithermal, *B. brevicauda* may have had a more extensive distribution on the plains than at present. In any event, probably then as now there was a cline of decreasing size from north to south in this species (Jones and Glass, 1960). In some manner, the central portion of the cline was obliterated in the western part of the range of this shrew, and two markedly different subspecies, the larger *B. b. brevicauda* and the smaller *B. b. carolinensis,* now meet along a fairly well-defined line in Nebraska with little intergradation between them. In the Xerothermic Period the short-tailed shrew, essentially a species of eastern forests, may have been eliminated from all but a few especially favorable areas in the central grasslands by the hot, dry climate and attendant changes in the vegetational complex (see Fig. 2), thus destroying in that region the middle part of the mentioned cline. When reinvasion took place following the Hypsithermal Interval, populations of this shrew dispersed to Nebraska from the southeast and the northeast in a kind of a "pincers movement," winning the "race" of resettlement as it were from elements within the contiguous range of the species directly east of Nebraska (Fig. 2). Large shrews invaded northeastern Nebraska, spreading out westward along river systems as far south as the Platte; small shrews invaded from the southeast, up the Missouri and out the Republican rivers. The two invading segments met just south of the Platte River excepting near the western extent of the range of the species where *carolinensis,* moving

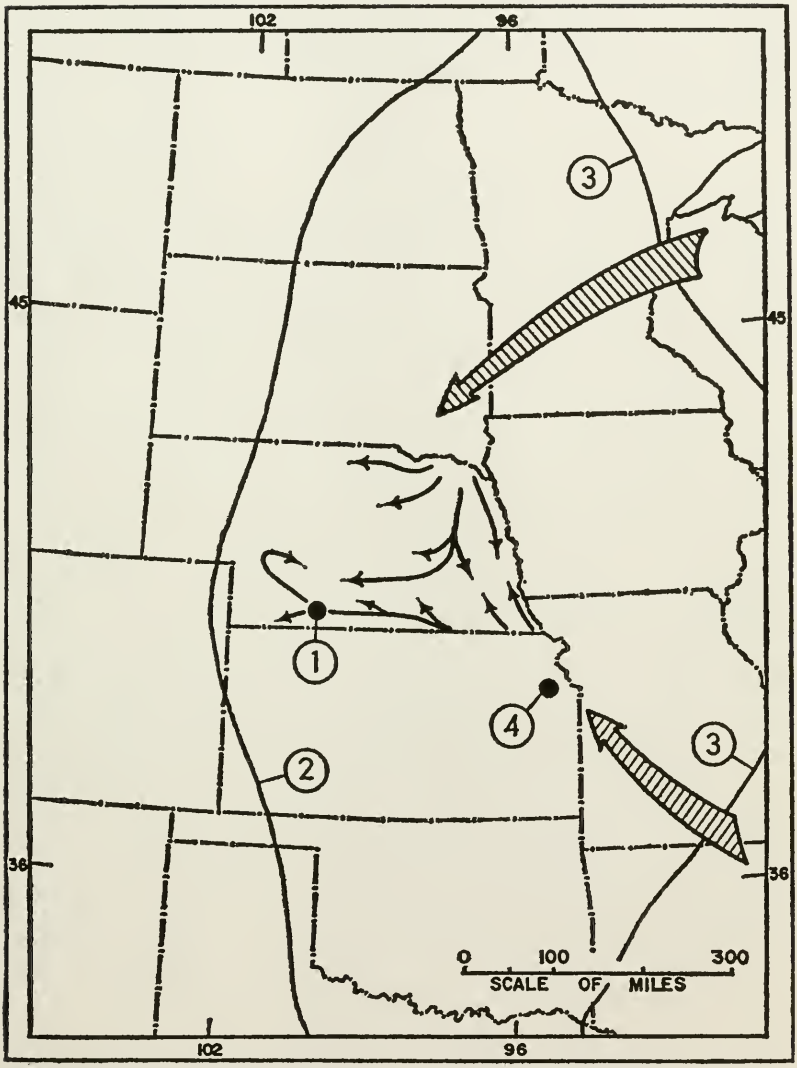

FIG. 2. Possible changes in the distribution of *Blarina brevicauda* in the grasslands region in response to post-Wisconsin shifts in climate. 1. Site in southwestern Nebraska where *Blarina* was found in association with early man. 2. Hypothetical western extent of the range of *B. brevicauda* in the Climatic Optimum. 3. Hypothetical western boundary of the continuous range of the species in the Xerothermic Period. 4. Site in Kansas River Valley where one isolated population may have existed in the Xerothermic Period. Large arrows indicate general direction of post-Hypsithermal dispersal of invading stocks from the continuous range of *B. brevicauda;* small arrows in Nebraska indicate dispersal routes therein. For present distribution of the species in Nebraska see Fig. 7.

out the Republican, breached the narrow gap between that drainage and the drainage of the Platte in Lincoln County and turned eastward, only to meet *brevicauda*, which was moving westward along the Platte.

But what of the isolated populations of *B. brevicauda* that must have been left scattered in favorable places in the eastern part of the grasslands in the Xerothermic Period? Some probably did not survive the duration of the Hypsithermal Interval; some that did were swamped, genetically speaking, by invading stocks from the main segment of the range of the species; but remnants of a few probably survive today. One such instance may be in the Kansas River Valley of northeastern Kansas where shrews from Douglas County and surrounding areas average appreciably larger cranially than shrews either to the north or south of them, and fit nearly perfectly as the missing middle segment into the otherwise sharply stepped north-south cline (Jones and Glass, 1960:fig. 1).

Logically, the Xerothermic Period was a time of extirpation over wide areas of the boreal elements that survived on the plains into Hypsithermal times. Only the hardiest remained, and these probably only in small, relatively or actually isolated areas in most or all instances. One imagines it was in this period when most of the unique boreal elements of the Black Hills were restricted thereon, and that the present relict populations of *Microtus pennsylvanicus* in southwestern Nebraska and *Synaptomys cooperi* in western Kansas and Nebraska were isolated. The present rather wide distribution in Nebraska of boreal species such as *Sorex cinereus, M. pennsylvanicus, S. cooperi, Zapus hudsonius*, and *Mustela nivalis* probably can be accounted for by limited post-Hypsithermal dispersal, for each occurs only where local conditions favor existence and each is absent from many apparently suitable areas in southern Nebraska and adjoining Kansas to which dispersal evidently has been prevented by intervening inhospitable terrain.

Admittedly, evidence of the effects of post-Wisconsin climatic shifts on mammals in Nebraska is scanty, the only real indication being in the distributional patterns previously discussed, but is, I think, significant. When one considers that many mammals (bats, most carnivores, ungulates) are readily mobile, that the biotic changes accompanying the climatic shifts discussed must have been exceedingly slow, that Nebraska lacks any real physical barriers to dispersal of most terrestrial organisms, and that suitable relict areas probably were few, it is surprising that any geographic evidence at

all remains. Future analyses of distributional patterns of plants and other animals may well shed additional light on this problem. Also, floral and faunal assemblages associated with dated archeological sites may come to light, and late Pleistocene and early Recent paleontological finds could help.

Changes since 2,500 BP

After the Hypsithermal Interval, the climate in the central United States cooled and became more humid, culminating in the conditions of the present (possibly it was somewhat cooler during the Little Ice Age than at present). Some minor fluctuations, to be sure, took place but none was so marked as in previous times.

According to present evidence (Dorf, 1959, and others) there has been a gradual warming trend on the North American continent in the last 100 years, response to which is seen in several species of mammals. The opossum has extended its range northward and westward notably in the last century and the range of the white-tailed jackrabbit has shifted northward on the plains in the last 50 years, in both instances probably relating, at least in part, to rising temperatures. The northward movement recorded in recent years of the pygmy mouse (*Baiomys taylori*), armadillo (*Dasypus novemcinctus*), ring-tailed cat (*Bassariscus astutus*), and hispid cotton rat (*Sigmodon hispidus*) also reflects this present warming trend. Of these, the cotton rat, which dispersed northward in Kansas in this century at an average rate of seven miles per year (Cockrum, 1948), finally was taken in Nebraska in the autumn of 1958 (Jones, 1960*b*), and the armadillo may reach the state in the next few years if it has not already done so. It is of interest to note that Pleistocene precursors of the cotton rat dispersed northward also in both the Aftonian and Yarmouth interglacial periods (Hibbard, 1958).

Emigration of Recent Mammals to Nebraska

Discounting the five introduced species and, for the moment, the 12 species of bats, the 69 native, non-volant species of Recent mammals in Nebraska fall more or less into five faunal units as regards their probable late Pleistocene and Recent geographic origin. The five units are Eastern, Grasslands, Southern-Southwestern, Northern-Western, and Widespread. Insofar as Nebraska is concerned, these faunal units indicate the geographic regions whence mammals reached the state, but not necessarily the areas of their ultimate origin. The gray fox, for example, would not be regarded as an

eastern species if its origin were considered, but is listed among eastern species in the arrangement beyond because it probably reached Nebraska from that general direction. Nebraska's position as a plains state that nearly bridges the gap between the eastern deciduous forests and the Rocky Mountains is, of course, reflected in the composition of its mammalian fauna, and accounts in part for the fact that so many as 45 (65 per cent) of the 69 species reach their distributional limits in the state.

Eastern Species

A relatively large segment of Nebraska's mammalian fauna invaded the state from the southeast, principally along the Missouri River. Many of the species are typical of the eastern deciduous forest and probably few or none of them lived in Nebraska at the time of maximal advance of the Wisconsin ice sheet. Some invaded the state early in post-Wisconsin time only to be displaced eastward in the wake of the xeric part of the Hypsithermal Interval or, in several instances, to remain in isolated populations, but others may be only post-Hypsithermal immigrants. Several (opossum, fox squirrel, gray fox, spotted skunk) are known to have extended their ranges westward in the state within historic time. All but the spotted skunk, and possibly the eastern cottontail and eastern mole, are thought to reach distributional limits in Nebraska (if the geographic limits of the ranges of two species last-named are not reached in parts of the Panhandle, they are reached just west of the Nebraska-Wyoming border).

Didelphis marsupialis
Blarina brevicauda
Cryptotis parva
Scalopus aquaticus
Sylvilagus floridanus
Marmota monax
Tamias striatus
Sciurus carolinensis
Sciurus niger
Glaucomys volans
Peromyscus leucopus
Neotoma floridana
Microtus pinetorum
Urocyon cinereoargenteus
Spilogale putorius

Grassland Species

Sixteen of the state's native, terrestrial mammals have definite affinities with the central North American grasslands—the tall-grass and mixed-grass prairies. All but one, the bison, are more or less restricted to this region, although the thirteen-lined ground squirrel and prairie vole presently occur as far east as Ohio, and several

species have invaded lower elevations in the Rocky Mountains or have crossed the mountains. The majority are characteristic inhabitants of the Great Plains, and not of the Central Lowlands to the east. Twelve (marked with an asterisk) reach distributional limits in Nebraska.

Lepus townsendii *
Cynomys ludovicianus *
Spermophilus franklinii *
Spermophilus richardsonii *
Spermophilus tridecemlineatus
Geomys bursarius
Perognathus fasciatus *
Perognathus flavescens *
Perognathus hispidus *
Reithrodontomys montanus *
Onychomys leucogaster *
Microtus ochrogaster
Vulpes velox *
Mustela nigripes *
Antilocapra americana *
Bison bison

The grasshopper mouse, *Onychomys leucogaster*, is questionably placed in this grouping because its distribution suggests to me that it is typically a grassland species that has secondarily moved westward, but a case could be made for its inclusion in the following category.

Southern-Southwestern Species

Most of the mammals comprising this element are characteristic of the arid southwestern United States and adjoining Mexican Plateau, and probably moved northward on the Great Plains to Nebraska in the warmer, drier post-Wisconsin periods. All but the western harvest mouse and the badger, which is questionably identified with this element, reach distributional limits in the state. The cotton rat, a species having tropical affinities, reached Nebraska, probably within the last ten years, directly from the south.

Sylvilagus audubonii
Lepus californicus
Dipodomys ordii
Reithrodontomys megalotis
Spermophilus spilosoma
Perognathus flavus
Sigmodon hispidus
Taxidea taxus

Northern-Western Species

Eleven species seem to owe their presence in Nebraska to displacement southward or eastward (or both) during Wisconsin glaciation. Each exists (or existed in historic time) either in restricted areas or, if widespread, in restricted habitats. All reach distributional limits in Nebraska, and in the broad sense can be regarded as "glacial relics."

Three of the species, the northern pocket gopher, bushy-tailed

woodrat, and mountain sheep, clearly are of western origin. The others evidence northern or widespread boreal affinities.

Sorex cinereus
Eutamias minimus
Thomomys talpoides
Neotoma cinerea
Microtus pennsylvanicus
Synaptomys cooperi
Zapus hudsonius
Mustela nivalis
Gulo luscus
Lynx canadensis
Ovis canadensis

Widespread Species

Species in this category have widespread distributions in North America and their origins are obscure insofar as Nebraska is concerned. Most or all probably occurred in suitable habitat in what is now Nebraska at the height of Wisconsin glaciation; only the four mentioned below possibly reached distributional limits in the state.

Three species included herein, the porcupine, grizzly bear, and mule deer, probably have western affinities but their Recent distributions are broad and do not necessarily suggest that they are "relics" of eastward movement in Wisconsin times. The red fox may have reached Nebraska from the east but the species now has a broad distribution in boreal and temperate North America and hence is tentatively listed here.

Castor canadensis
Peromyscus maniculatus
Ondatra zibethicus
Erethizon dorsatum
Canis latrans
Canis lupus
Vulpes vulpes
Ursus americanus
Ursus horribilis
Procyon lotor
Mustela frenata
Mustela vison
Mephitis mephitis
Lutra canadensis
Felis concolor
Lynx rufus
Cervus canadensis
Odocoileus hemionus
Odocoileus virginianus

Bats

Being volant, and thus exceedingly mobile, bats sometimes are difficult to categorize as to faunal relationship. Nevertheless, relationships are apparent for most of the 12 species occurring in Nebraska. Five kinds, *Myotis lucifugus, Myotis subulatus, Eptesicus fuscus, Lasionycteris noctivagans,* and *Lasiurus cinereus* are widely distributed in North America and indicate no particular faunal affinities, although *M. subulatus* is distributed principally in the temperate region of the west and *L. noctivagans* evidently occurs in Nebraska only as a migrant, breeding to the north of the

state, but wintering mostly to the south. *Myotis keenii, Pipistrellus subflavus, Lasiurus borealis,* and *Nycticeius humeralis* reached Nebraska from the east, although *M. keenii* has a disjunct subspecies on the west coast, possibly resulting from isolation in glacial times, and *L. borealis,* which is widespread in temperate and tropical areas of the New World, is represented in temperate North America by two subspecies (*L. b. borealis* in the east and *L. b. teliotis* in the west) that evidently do not meet geographically. *Myotis evotis* and *Myotis volans* clearly are species of the intermountain west and in Nebraska occur only in the extreme northwestern part of the state where suitable habitat prevails. *Tadarida brasiliensis,* known only by three isolated occurrences in Nebraska, is a straggler of tropical affinities from the south.

Some Effects of the Environment

Some effects of the environment on the geographic distribution of organisms are easily understood because a single, obvious factor limits a given species. In other instances the effect of the environment is poorly understood because the limiting factor is obscure or, more frequently, because a combination of environmental factors interact to limit distribution. Some apparent correlations between mammalian distribution and the environment in Nebraska are mentioned, by way of example, below.

Edaphic factors

Some species of mammals prefer, or are limited to, certain types of soil. Rodents of the families Geomyidae and Heteromyidae well illustrate this point in Nebraska. The plains pocket gopher (*Geomys bursarius*), while state-wide in distribution, seems to prefer loose soils, is most abundant in sand or sandy loam, and is common in certain areas of silt loam (loess). It avoids rocky soils and generally is rare or absent in hard, clayey substrates. The northern pocket gopher (*Thomomys talpoides*), on the other hand, occurs only in areas of the Panhandle where soils are mostly thin and the substrate, in general, compact and hard. Among the pocket mice, *Perognathus fasciatus* seems to occur only on thin, hard soils that in many places contain rock, *P. flavus* and *P. flavescens* prefer pliable soils of high sand content, although both occur in some other types as well, and *P. hispidus* shows no marked predilection for any particular substrate, but may prefer sandy loess to other types. The kangaroo rat (*Dipodomys ordii*) mostly occurs on

loose, predominately sandy soils; it is commonest on the Sand Hills and in areas where loess and sand are mixed, is relatively rare on the harsh, thin soils of the Panhandle, and is limited eastwardly by the deep loess soils on which tall-grass prairie grows. The easternmost occurrences of *D. ordii* (Antelope, Knox and Platte counties) are at places where loose, relatively sandy soil intrudes locally into loess. Along with soil, tall-grass prairie itself may well play a part in limiting the kangaroo rat because the saltatorial mode of locomotion of this species would be greatly hindered by thick, tall vegetation of any kind.

Vegetation

Vegetation is an important limiting factor because it provides both food and cover for some mammals. Some kinds occur only in deciduous timber, some only where tall grasses prevail, some only in wet, marshy areas, and still others only on arid grasslands that are partly denuded of vegetation. In many areas of western Nebraska, for example, the eastern cottontail (*Sylvilagus floridanus*) occurs only in the relatively lush vegetation along streams, and the desert cottontail (*S. audubonii*) occurs only on relatively barren uplands. The local distribution of the two species overlaps only narrowly along the edges of valleys.

As a group, members of the family Sciuridae illustrate well the effect of vegetation on distributional limits of mammals in Nebraska. Five species, the eastern chipmunk (*Tamias striatus*), woodchuck (*Marmota monax*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), and southern flying squirrel (*Glaucomys volans*) are kinds associated with eastern deciduous forests. One, the least chipmunk (*Eutamias minimus*), is generally associated with coniferous forest. The remainder, the black-tailed prairie dog (*Cynomys ludovicianus*) and four species of ground squirrels, are grassland inhabitants.

The eastern chipmunk, gray squirrel, and flying squirrel all are limited to dense stands of deciduous timber in extreme eastern Nebraska. For the gray squirrel, incident light during periods of activity (related to cover) may be the limiting factor (Packard, 1956:32), whereas availability of favored homesites or foods, or both, may limit the other two species. The woodchuck occurs westward some distance from continuous stands of deciduous trees, generally following along wooded valleys of streams. Possibly the

availability of preferred den-sites, on wooded hillsides and at the border of copses, limits this rodent. The fox squirrel, by far the most tolerant of environmental conditions of any of the five eastern kinds, occurs all the way to the western border of the state in the Platte Valley and in the Pine Ridge area. This species has extended its range westward in historic time, both through natural dispersal and through introduction, and seemingly is limited only by the limit of deciduous timber itself. In western valleys, where nut- and fruit-producing trees are rare or absent, corn and other cultivated grains are the principal foods.

The least chipmunk is restricted to the Pine Ridge and Badlands of the northwestern part of the state where it frequently, but not always, is associated with conifers (*Pinus* or *Juniperus*). Actually, the availability of rocky areas for homesites may be the principal factor limiting *E. minimus.*

Of the grassland species, four (*C. ludovicianus, S. spilosoma, S. townsendii* and *S. tridecemlineatus*) are typically species of the Great Plains, but the fifth (*S. franklinii*) is an inhabitant of the tall-grass prairie and has spread westward along river valleys in recent years as a result of agricultural practices. The prairie dog occurs principally in areas where grasses and other plants are short as a result of overgrazing (formerly by bison, presently by cattle), fire, or other factors; the species seems not to survive long in climax associations of grasses. *S. tridecemlineatus,* which now occupies a broad distribution in the central United States, occurs within the original confines of tall-grass prairie principally in disturbed areas where relatively short vegetation now prevails.

Several mammals that are typical inhabitants of the arid Great Plains occur farther to the eastward in Nebraska than in neighboring states—some well into the tall-grass prairie. Possibly this is because no marked physiographic break is present, as elsewhere, between the Great Plains and the Central Lowlands.

Watson E. Beed (1936) studied ecological conditions on the Ft. Niobrara National Wildlife Refuge in the only study of its kind in Nebraska of which results have been published. He divided the area studied into nine "biotic communities," and the list of mammals found in these communities, summarized here in tabular form (Table 2), illustrates the occurrence of mammals locally in different vegetative associations.

TABLE 2.—DISTRIBUTION OF MAMMALS IN BIOTIC COMMUNITIES ON THE FT. NIOBRARA NATIONAL WILDLIFE REFUGE (AFTER BEED, 1936).

SPECIES	Communities								
	Short Grass	Rock Outcrop	Western Yellow Pine	Scrub Thicket	Streamside Forest	Dry Meadow	Wet Meadow	Swamp	Open Water and Shore
Sorex cinereus					X		X		
Blarina brevicauda				X	X	X	X		
Scalopus aquaticus				X	X	X			
Sylvilagus floridanus	X	X		X	X				
Lepus californicus	X								
Lepus townsendii	X	X	X						
Cynomys ludovicianus	X								
Spermophilus tridecemlineatus	X								
Sciurus niger				X	X				
Geomys bursarius						X			
Perognathus fasciatus	X								
Perognathus flavescens	X								
Perognathus flavus	X								
Perognathus hispidus	X	X	X						
Dipodomys ordii	X								
Castor canadensis									X
Reithrodontomys montanus	X								
Peromyscus leucopus	X	X	X						
Peromyscus maniculatus	X	X		X	X	X	X		
Onychomys leucogaster	X								
Microtus ochrogaster					X	X			
Microtus pennsylvanicus					X	X	X		
Ondatra zibethicus								X	X
Zapus hudsonius					X	X			
Erethizon dorsatum			X						
Canis latrans	X		X	X	X	X			
Procyon lotor					X		X	X	X
Mustela frenata	X	X	X	X	X	X			
Mustela nivalis				X	X	X			
Mustela vison					X		X	X	X
Taxidea taxus	X								
Spilogale putorius	X	X		X	X	X			
Mephitis mephitis	X	X	X	X		X			
Lynx rufus**		?	?	?	?				
Cervus canadensis*	X		X	X	X	X			
Odocoileus hemionus*	X			X		X			
Antilocapra americana*	X								
Bison bison*	X		X						

* Introduced, but originally occurred in this area.

** Not recorded from any particular community, but noted (p. 19) as occurring in the area.

Climate

Direct effects of climate on distributional patterns of mammals sometimes are difficult to perceive. Indirect effects, on the other

hand, are easily perceived and underscore the contention that interaction of environmental factors, more frequently than one factor, limits the distribution of mammals. The shift eastward of the mixed-grass prairie during the "great drought" (1933-41) by as much as 150 miles (Weaver and Bruner, 1954:122), for example, certainly affected some kinds of mammals; probably it is significant that the easternmost occurrences in Nebraska of two species having affinities in the arid southwest (*Perognathus flavus* and *Sylvilagus audubonii*) were recorded in that period. Climatic shifts of this kind could destory important relict habitats as well.

One species that climate does seem to affect directly is the hispid cotton rat (*Sigmodon hispidus*). In four of the last 14 winters at Lawrence, Kansas, prolonged periods of low temperatures or a heavy ground-cover of ice and snow, or both, have drastically reduced numbers of *S. hispidus* and are thought to be the principal factors limiting continued northward dispersal of the species.

The mole (*Scalopus aquaticus*) also is affected directly by climate in that in many areas, especially in the drier parts of the state, individuals are active only in moist soils. Increased rainfall, then, leads to greater dispersal of moles, and could result in movement to suitable habitats formerly isolated and unoccupied. Conversely, extreme aridity excludes moles from areas that at other times are inhabited.

Topography

Nebraska lacks striking topographic barriers to dispersal of mammals. Nevertheless, topographic features (or their absence) influence in one way or another the distribution of many species. The rocky areas of the Panhandle, for instance, provide the only suitable habitat for the least chipmunk (*Eutamias minimus*) and the bushy-tailed woodrat (*Neotoma cinerea*), and provide also places of retreat for several species of bats that do not occur elsewhere in the state. The lakes of the Sand Hills and other bodies of water provide, indirectly, suitable habitat for many riparian species; the vast areas in Nebraska where permanent water is lacking are devoid of aquatic and semi-aquatic species and generally lack those kinds that occupy riparian situations.

The Missouri River as a Barrier to Dispersal

As noted previously, the deciduous riparian association along the Missouri River probably served as a pathway for invasion of the Central grasslands by some eastern mammals. This same association or the river itself (or both) have prevented the dispersal east-

ward of at least nine other species at the latitude of Nebraska. The nine, all typical of arid or semi-arid grasslands, are *Lepus californicus, Lepus townsendii, Cynomys ludovicianus, Perognathus flavescens, Perognathus hispidus, Onychomys leucogaster, Vulpes velox, Mustela nigripes,* and *Antilocapra americana.* For all but *P. hispidus,* the deciduous woodlands that border the river probably served as the barrier. The ranges of several of these species approach (or formerly approached) the Missouri near the Nebraska-South Dakota border, and farther north in the Dakotas, where the deciduous vegetation thinned and become discontinuous in some sections, some crossed the river and expanded their ranges into the tall-grass prairie to the east. In this manner, *Lepus townsendii, Perognathus flavescens, Onychomys leucogaster* and *Antilocapra americana* came to occupy geographic areas to the east of Nebraska even though the area along the Missouri was a barrier to them at that latitude.

Perognathus hispidus presents a somewhat different problem. The species probably occupies favorable habitats all along the western side of the river in Nebraska. It has even been taken on the flood plain (in Richardson County), a habitat possibly occupied only recently, but is not known east of the river except at one place in central South Dakota. Because it now occupies the flood plain, *P. hispidus* might be expected soon to gain access to the eastern side, except that the Missouri itself now may be an effective barrier for reasons outlined beyond.

Deciduous trees along the Missouri may have been a barrier also, or at least partly so, to the mule deer (*Odocoileus hemionus*) in historic time, but in recent years individuals have been taken along parts of the river on both the Iowa and Nebraska sides, and recent records place marginal occurrence of the species far eastward in Iowa. The kangaroo rat (*Dipodomys ordii*) might be mentioned also in this connection. The eastern margin of its range occurs, for the most part, far to the west of the Missouri, where it is limited by other factors, but in northeastern Nebraska and adjacent parts of South Dakota this species reaches, but does not cross, the river.

For mammals that could pass through the deciduous woodlands, the Missouri has proved to be no barrier at all. The list of subspecies occurring on both sides of the river is impressive, and includes both semi-fossorial and fossorial kinds. The partial list below of subspecies that occur on both sides of the river suffices to establish the point:

PLATE 1

Fig. 1. Upland habitat in eastern Nebraska (north edge of Lincoln, Lancaster County). Formerly grazed, this area had not been disturbed for six years at the time this photograph was taken. Photograph courtesy of the University of Nebraska State Museum.

Fig. 2. Hills above the Missouri in northern Knox County. The photograph shows native prairie in foreground, deciduous timber (mostly oak) in draws, and floodplain of the river in the distance.

PLATE 2

Fig. 1. Shallow, sandy-bottomed Middle Loup River in Sand Hills, 1 mi. N and 4 mi. W Halsey, Thomas County. Note thin border of deciduous trees.

Fig. 2. Watt's Lake, Valentine National Wildlife Refuge, Cherry County. Typical of the lake region of the Sand Hills, this photograph shows recently mowed hay, lake-side vegetation, open water, and sand hills in distance.

PLATE 3

Fig. 1. Pond and associated vegetation at Rock Creek Fish Hatchery, Dundy County. This interesting area in southwestern Nebraska provides suitable habitat for many riparian mammals, including relict populations of two microtines.

Fig. 2. Pine-capped Wildcat Hills in southern Scotts Bluff County.

PLATE 4

Fig. 1. Typical view (at Fort Robinson, Dawes County) of Pine Ridge. Note cliffs and rocky slopes, which provide important habitats for some mammals.

Fig. 2. Deciduous timber along Soldier Creek in Pine Ridge area of eastern Sioux County.

Cryptotis parva parva
Scalopus aquaticus machrinoides
Sylvilagus floridanus mearnsii
Spermophilus tridecemlineatus tridecemlineatus
Geomys bursarius majusculus
Reithrodontomys megalotis dychei
Peromyscus maniculatus bairdii
Microtus ochrogaster ochrogaster
Microtus pinetorum nemoralis
Mustela nivalis campestris

The boundary line between subspecies of four species currently is drawn along the Missouri at the latitude of Nebraska. In the northeast, the nominal subspecies *Onychomys leucogaster breviauritus* occurs to the south and west of the river, whereas *O. l. leucogaster* occurs to the north and east of the river in South Dakota. For the remaining three species, *Marmota monax, Erethizon dorsatum* and *Canis latrans,* the Missouri provides a boundary of convenience between subspecies and in each instance the line probably reflects lack of precise knowledge as much as anything. I cannot conceive of the river as an effective barrier to any of these three species.

How do mammals cross large rivers that present potential barriers to dispersal? Principally in one of three ways: 1) swim; 2) cross on ice in winter if the river freezes over; and 3) cross as a result of flooding, either by rafting or by climbing to safety in tall vegetation, which, owing to changes in the channel that so often result from floods, ends up with its occupant on the opposite side after the water has receded. All of these methods are important, the first two especially to larger mammals and the last to smaller species. (Occasionally mammals cross rivers as a result of acts of man—by direct transport or on man-made structures such as bridges and dams—but known crossings of this kind are relatively few and of little concern here.)

Because of recent changes wrought by man on the Missouri to make it more useful and reliable for river transportation, and to prevent flooding (by equalizing the flow), it perhaps now is more of a barrier than in the past, at least to small mammals. The channel has been straightened and deepened and is kept partly ice-free in winter, thus reducing the chances of a mammal successfully swimming the river and the opportunity of crossing on ice. The series of dams in the Missouri from the Nebraska-South Dakota line north into Montana have considerably reduced flooding north of the

mouth of the Kansas River, thereby all but preventing crossing by that means at the latitude of Nebraska. For these reasons, the river now may provide an effective barrier to *P. hispidus* (whereas it would not have done so in the past) and may reduce considerably gene-flow between populations of species now occurring on both sides.

The Missouri River is by far the largest body of flowing water that touches Nebraska. Other rivers in the state, except as they have provided avenues of dispersal for species utilizing riparian associations, seem not to have affected the distribution or speciation of mammals.

Geographic Variation and Speciation

Geographic variation among Nebraskan mammals mirrors fairly well that found in other plains states at the same longitude, namely variation in color of pelage from east (dark) to west (pale) in many species, sometimes accompanied by variation in size, and clinal north-south variation in size in a few species, in general accordance with several zoogeographic rules pertaining to infraspecific variation.

Color of pelage in mammals oftentimes reflects the color of the substrate on which they live. Some species in Nebraska having dark subspecies in the east and pale subspecies in the west that serve to illustrate this point are the following:

Species	Dark, Eastern Subspecies	Pale, Western Subspecies
Scalopus aquaticus	*machrinoides*	*caryi*
Sylvilagus floridanus	*mearnsii*	*similis*
Spermophilus tridecemlineatus	*tridecemlineatus*	*pallidus*
Geomys bursarius	*majusculus*	*lutescens*
Perognathus flavescens	*perniger*	*flavescens*
Peromyscus maniculatus	*bairdii*	*luteus* and *nebrascensis*
Onychomys leucogaster	*breviauritus*	*arcticeps*
Microtus ochrogaster	*ochrogaster*	*haydenii*
Mustela frenata	*primulina* and *spadix*	*longicauda*

Species in which east-west variation in color of pelage is lacking, or of such minor slope as not to be recognized subspecifically, are mostly 1) kinds that can move readily over broad areas (bats, ungulates and carnivores, for example), or 2) species that, although relatively widespread, are narrowly limited ecologically in areas where differentiation might be expected. Examples of the latter are found among some rodents and insectivores that occur only in riparian communities in the western part of the state where ecological conditions approximate those under which the mammal lives

in the east (*Microtus pennsylvanicus, Blarina brevicauda,* and *Reithrodontomys megalotis,* for example). For those species in which color of pelage varies from east to west and provides characters separating subspecies, the change in color ordinarily is gradual (as is the change in color of soil), resulting in relatively broad zones of intergradation between most subspecies. Significantly, boundaries between the eastern and western subspecies of most species fall in the same general area. Most specimens from Neligh, Antelope County, at the easternmost edge of the Sand Hills, for example, are intergrades regardless of the species concerned; specimens from Neligh of some species are assignable to an eastern subspecies, but in more species individuals resemble to a greater degree a western subspecies. Geographic variation in color of pelage in *Peromyscus maniculatus,* one of the most geographically variable of the mammals occurring in Nebraska, is illustrated, by way of example, in Fig. 3.

More often than not the eastern of two subspecies is the larger (in *Scalopus aquaticus, Spermophilus tridecemlineatus,* and *Geomys bursarius,* for example), but sometimes the opposite is the case (in *Peromyscus maniculatus,* for example), and in some instances there is little or no difference in size between the two. If eastern and western subspecies differ in size, the changes are gradual, as are changes in color, but changes in size and color ordinarily do not occur at the same rate or at the same places—in other words they are not ordinarily concordant. Because the zones of intergradation between eastern and western subspecies usually are broad, assignment of specimens from some localities therein is difficult, especially where small series or single specimens are involved, and on occasion must be made solely on geographic grounds.

North-south variation in mammals in Nebraska is marked only in a few species. In *Blarina brevicauda* for example, the northern subspecies (*B. b. brevicauda*) is strikingly larger than the southern race (*B. b. carolinensis*), but this results from peculiar circumstances, previously noted, associated with shifts in range of this species in response to post-Wisconsin climates. Of the two subspecies of the kangaroo rat that occur in the state, the northern one (*D. o. luteolus*) is supposedly the larger (Setzer, 1949:512), but the differences are slight because Nebraska lies in the zone of intergradation between the two. In several species (*Sylvilagus audubonii, Zapus hudsonius, Vulpes vulpes,* and *Mephitis mephitis,* for example) size increases northwardly but the same subspecific name is applied throughout the range in Nebraska.

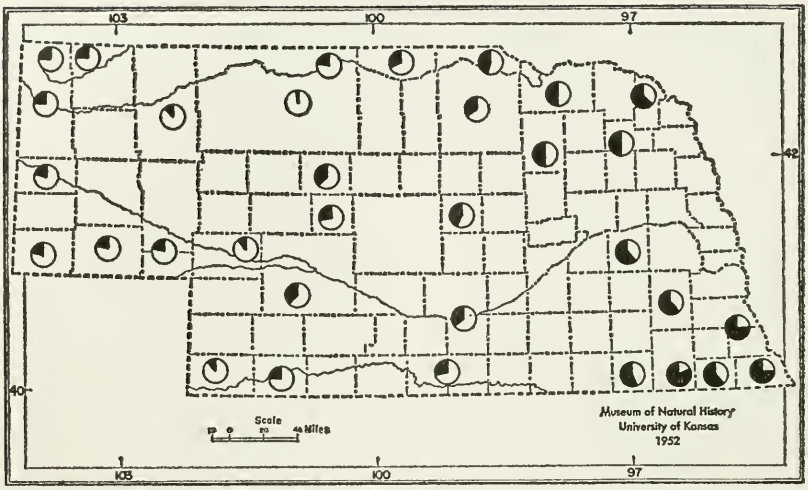

FIG. 3. Schematic representation of color of pelage in *Peromyscus maniculatus* in Nebraska showing changes from east (dark) to west (pale). To arrive at color designations five specimens were selected as "guides" as follows: an average specimen from among the darkest-colored individuals was designated no. 1; an average specimen from among the palest available was designated no. 9; specimens of appropriate intermediate colors were designated nos. 3, 5, and 7. Adults from the localities represented in the figure were compared with the numbered specimens and assigned a color designation of from 0 to 10. Averages, all of which fell between 1 and 8, are indicated above for the samples treated. If the average from any locality had been 1 the symbol representing that locality would have been entirely black; if the average had been 8 the symbol would have been entirely white.

Some series from the Panhandle have approximately the same color rating as do series from more easterly localities, but individuals from the Panhandle are slightly more grayish in most instances than those of approximately the same color rating to the east. Dice (1941) and Blair (1953) are among those who previously have studied variation in color in this species in Nebraska.

In the western harvest mouse, *Reithrodontomys megalotis dychei*, there is a general increase in length of tail and length of ear from northeast to southwest in the state, in accord with Allen's Rule, and an increase in length of rostrum as well (Jones and Mursaloğlu, 1961:fig. 1).

Nebraska has but two endemic subspecies, *Neotoma floridana baileyi* and *Synaptomys cooperi relictus*. Each occurs in an isolated, relict area and each possibly occurs in adjoining parts of another state. Another relic, *Microtus pennsylvanicus finitus*, occurs with *S. c. relictus* along Rock Creek in Dundy County but is known also from along the North Fork of the Republican River in adjacent Yuma County, Colorado.

It is somewhat surprising that the Sand Hills of Nebraska, occupying some 18,000 square miles, not including isolated outliers,

have produced no endemic subspecies of mammals. Some kinds, it is true, are somewhat paler there than elsewhere within their geographic distribution (*Dipodomys ordii luteolus* and *Peromyscus maniculatus luteus*, for example), but on the whole populations of mammals on the Sand Hills closely resemble in color those on adjacent pale-colored soils. The Sand Hills have served as a kind of a filter zone to distribution of mammals. Some eastern species reach the area along rivers but do not pass through it and, similarly, some species of arid regions range eastward into the Sand Hills but do not occur east of them.

MAMMALIAN DISTRIBUTIONAL AREAS

No one of the arrangements devised to categorize North America biotas, of which the Life-zones of C. H. Merriam, the Biotic Provinces of L. R. Dice, and the Biomes of Clements and Shelford are the most widely cited, corresponds, except in a most general way, with the patterns of distribution of Nebraskan mammals. I have, therefore, divided the state into four mammalian distributional areas, two of which are subdivided into two distributional districts each. It is my hope that the provision of a suitable arrangement for mammals may aid persons who study other animals in Nebraska and that one day, when other organisms are as well known as mammals, one of the major systems mentioned, or some other, can be applied to them all. Of the three systems noted above, Biotic Provinces appeal to me as possibly being most useful in a plains state, because they are contiguous and can readily be subdivided into Biotic Districts, which themselves can be subdivided into ecological associations or some other arrangement if need be. The student interested in the various schemes proposed to classify ecologically the floras and faunas of North America is directed to Kendeigh's (1954) valuable review of the subject.

Wolcott (1906), Swenk (1908), and Wolcott (1909) each divided Nebraska into five faunal areas. The three divisions generally were in accord, differing in some instances only in names used for the faunal units recognized, as seen below:

WOLCOTT (1906)	SWENK (1908)	WOLCOTT (1909)
Wooded bluffs and bottoms of the Missouri and its tributaries	Missouri	Missouri
Prairie	Prairie	Prairie
Sand-hill	Sandhill	Sand-hill
Plains or plateau	Plateau	Plains
Coniferous wooded region of the northwest, extending eastward north of the Niobrara	Pine Ridge	Pine Ridge

The mammalian distributional areas here recognized (see Fig. 4) are Missouri, Eastern Grassland, Central Grassland, and Panhandle. The Central Grassland Area is divided into a Sand Hill District and a Southwestern District, and the Panhandle Area is divided into a Plains-Plateau District and a Pine Ridge-Badlands District. These several areas correspond roughly with the major soil, vegetational and physiographic areas of the state.

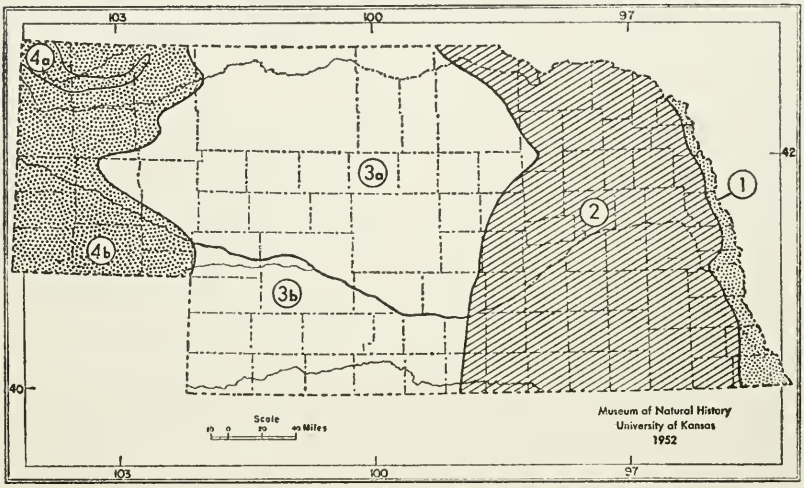

FIG. 4. Mammalian distributional areas in Nebraska. 1. Missouri. 2. Eastern Grassland. 3. Central Grassland (Sand Hills District, 3a, Southwestern District, 3b). 4. Panhandle (Pine Ridge-Badlands District, 4a, Plains-Plateau District, 4b).

Missouri Distributional Area

This area approximates the former extent of climax oak-hickory forest along the Missouri River in extreme eastern Nebraska. Six kinds of mammals (*Myotis lucifugus lucifugus, Pipistrellus subflavus subflavus, Tamias striatus griseus, Sciurus carolinensis pennsylvanicus, Glaucomys volans volans,* and *Microtus pinetorum nemoralis*) are more or less restricted thereto. Other kinds characteristic of this area include *Didelphis marsupialis virginiana, Nycticeius humeralis humeralis, Sciurus niger rufiventer,* and *Peromyscus leucopus noveboracensis.*

Eastern Grassland Distributional Area

The tall-grass prairie and part of the ecotonal area between tall- and mixed-grass prairie are included in this distributional area. It is bounded on the east by the wooded areas along the Missouri.

The western margin, which approximates the 99th meridian in the extreme north and to the south of the Platte River, bends eastward in the middle of the state to skirt the eastern edge of the Sand Hills and adjacent relatively sandy areas. Subspecies of several grassland species (*Perognathus flavescens perniger*, *Reithrodontomys montanus griseus*, and *Onychomys leucogaster breviauritus*, for example) are restricted to this area. *Cryptotis parva parva*, *Spermophilus franklinii*, *Synaptomys cooperi gossii*, *Vulpes vulpes regalis*, and *Spilogale putorius interrupta* are among the characteristic inhabitants, along with eastern subspecies (*Spermophilus tridecemlineatus tridecemlineatus* and *Microtus ochrogaster ochrogaster*, for example) of some wide-ranging species.

There are a few faunal differences between the northern and southern parts of this area but these do not to my mind justify the creation of two districts.

Central Grassland Distributional Area

This faunal unit comprises the Sand Hills and adjacent areas of sandy soil north of the Platte River and sandy outliers and adjacent areas to the south of the Platte. The western border north of the river is the border of the Sand Hills; south of the Platte, the isolated areas of dune sand between the 101st and the 102nd meridians form the western boundary.

Only a few mammals are restricted to this area. Mostly it serves to filter western species moving east and, in part, eastern species moving west, although some of the latter have passed through the area along the riparian community bordering the Platte River. Two faunal districts are recognized, one divided from the other by the Platte.

Sand Hills District.—Included herein are the Sand Hills proper, areas of sandy loess to the south of them, and the tablelands north of the Niobrara in northeastern Cherry, Keya Paha, and western Boyd counties. Only two mammals, *Neotoma floridana baileyi* and *Perognathus fasciatus fasciatus*, are peculiar to this district and both of these occur only in restricted areas therein. Mostly the district is characterized by the abundance of *Geomys bursarius lutescens*, *Perognathus flavescens flavescens*, *Dipodomys ordii luteolus*, *Peromyscus maniculatus luteus*, and some other upland kinds, and the abundance of certain riparian mammals (such as *Sorex cinereus haydeni*, *Zapus hudsonius pallidus*, *Microtus pennsylvanicus pennsylvanicus*, and *Ondatra zibethicus cinnamominus*) along the rivers and around the many Sand Hill lakes and marshes.

Southwestern District.—That part of the Central Grassland Area lying to the south of the Platte River comprises this district. It is characterized by lacking generally the conditions described above for the Sand Hills District and by the presence of *Dipodomys ordii richardsoni, Neotoma floridana campestris, Microtus pennsylvanicus finitus,* and *Synaptomys cooperi relictus.*

Panhandle Distributional Area

That part of Nebraska lying west of the Sand Hills is included in this area. Mammals characteristic of this faunal unit as a whole, some nearly or absolutely limited to it, are *Myotis subulatus subulatus, Eptesicus fuscus pallidus, Sylvilagus audubonii baileyi, Perognathus fasciatus olivaceogriseus, Peromyscus maniculatus nebrascensis, Neotoma cinerea rupicola, Gulo luscus luscus,* and *Ovis canadensis auduboni.*

Pine Ridge-Badlands District.—This district is confined to the Pine Ridge in Sioux, Dawes, and northwestern Sheridan counties and to the Badlands north of Pine Ridge, mostly in parts of Sioux County. Mammals peculiar to this area are *Myotis evotis evotis, Myotis volans interior,* and *Eutamias minimus pallidus. Myotis lucifugus carissima* and *Erethizon dorsatum bruneri* are characteristic inhabitants but are not limited to this district.

Plains-Plateau District.—That area of the Panhandle not included in the Pine Ridge-Badlands District is included here. *Spermophilus richardsonii elegans* and two subspecies of *Thomomys talpoides, T. t. cheyennensis* (south) and *T. t. pierreicolus* (north) occur only in this district. It is characterized additionally by lacking those kinds limited to the district previously mentioned.

Summary

At the height of Wisconsin glaciation, the mammalian fauna of what is now Nebraska probably was composed of boreal species, wide-ranging species, and some of the more cold-tolerant temperate species, including kinds having grassland affinities. With the retreat of the Wisconsin ice sheet, boreal elements became fewer and temperate species increased in number. It is postulated that post-Wisconsin climatic shifts, especially the Hypsithermal Interval, with its warm, humid Climatic Optimum (9,000-4,000 BP) and succeeding warm, dry Xerothermic Period (4,000-2,500 BP), played an important role in the establishment of the present distributional patterns of some species (*Neotoma floridana* and *Blarina brevicauda,* for example). The Xerothermic Period probably was a time when the boreal elements still remaining were extirpated or drastically restricted geographically.

Five faunal units are recognizable among Nebraska's 69 Recent, native, non-

volant species as follows: 1) northern and western species that were forced southward or eastward by continental or montane glaciation during the Wisconsin and that now occur in the state mostly in restricted areas; 2) a group of species that invaded the state from the east, principally along the Missouri River; 3) grassland species, which are characteristic of (and many endemic to) the central North American grasslands; 4) southern and southwestern species, most of which are characteristic of the Sonoran region, that invaded the state from the southern Great Plains; and 5) a large group of wide-ranging species of undetermined origin insofar as Nebraska is concerned. Of the 12 species of bats, five are widespread, four appear to have invaded the state from the east, two are species characteristic of the intermountain west, and one (*Tadarida brasiliensis*) is a wanderer from the south.

Environmental conditions control distribution of many mammals in Nebraska. The presence or absence of certain plant associations seems to be most important in this regard but edaphic, climatic, and topographic factors also serve to limit distribution of mammals, and sometimes a combination of factors involving more than one of the major environmental categories is operative. The Missouri River and especially its deciduous riparian association have been barriers to eastward dispersal of at least nine plains species (and possibly several more), although the river and its riparian association have not been barriers to many small mammals judging from the impressive number of subspecies that occur both to the east and west of the river.

The predominant geographic variation among Nebraskan mammals is in color of pelage from east (dark) to west (pale) and accords with Gloger's rule. No fewer than 15 species have pale western and dark eastern subspecies; variation in color in the same direction is apparent in a number of other species but is not of a magnitude that warrants subspecific recognition. East-west variation in size occurs in some species but is lacking in many others. Clinal variation in size from north to south is apparent in a few species and is in general accordance with Allen's and Bergmann's rules.

Considering climate, soil, vegetation, and topography along with distribution and speciation among mammals in Nebraska, the state can be divided into four mammalian distributional areas (see Fig. 4) as follows (from east to west): Missouri; Eastern Grassland; Central Grassland (having the Sand Hills and Southwestern districts); and Panhandle (having the Pine Ridge-Badlands and Plains-Plateau districts). Each of these distributional areas is characterized by the presence (or absence) of mammals in unique combinations.

TREATMENT AND ACKNOWLEDGMENTS

The aims of the present report have been the following: 1) to determine the kinds of Recent mammals occurring (or that occurred within historic time) within the political boundaries of Nebraska; 2) to ascertain for each the extent of geographic distribution in the state; 3) to provide keys for ready identification of species; 4) to provide, insofar as I was able, a complete synonymy with reference to Nebraska for each of the subspecies and monotypic

species treated; 5) to assess taxonomically, and to record if appropriate, variations of all kinds—specific, subspecific, geographic, and individual—found in the mammals studied; and 6) to relate, whenever possible, distribution and speciation of Nebraskan mammals to the late Pleistocene and Recent changes in the environment.

Methods

The arrangement of major taxonomic categories (from order to genus) in the accounts of species beyond follows Hall and Kelson (1959). Species of each genus and subspecies of each species are entered alphabetically for convenience of the reader. Each of the seven orders of Nebraskan mammals is discussed briefly. The names of the 23 families to which the 86 mammalian species of the state belong are appropriately placed in the text. A given vernacular name is applied to the species and is intended to apply to all of its subspecies. The reader is reminded again that the study here reported on was mainly from the systematic, not the ecologic, viewpoint. I have, nevertheless, attempted to summarize some data on reproduction for each species, because such information frequently is available only on specimen labels; for the sake of consistency, brief mention is made of reproduction for each species, even if information from Nebraska is lacking.

After the general discussion of a species, each subspecies or monotypic species is treated as follows:

1. The *scientific name* that is valid under the rules of the "International Code of Zoological Nomenclature" (1961) is followed on the same line by the name of the author.

2. The *synonymy*, in which the first citation is to the original description, which I have consulted in every instance, followed by designation of the type locality. The second citation is to the first use of the name-combination herein employed if it differs from the name as originally proposed. Next, in chronological order, are all citations in the literature pertaining to Nebraskan mammals for which at least a binomial was used. By "pertaining to Nebraska" I mean one of the following: record of Nebraska-taken material (specimen or specimens); mention of a precise locality of occurrence (excepting simple listings of Nebraskan type localities); or listing of a name with reference only to Nebraska even if no specimens or precise localities were mentioned (as in the checklists of Aughey, 1880, Swenk, 1915, and Jones, 1957, for example). The word "part" appears in parentheses after a name in synonymy if that name was applied only in part, in any combination, with reference to Nebraska.

3. The geographic *distribution in Nebraska* stated in concise form.

4. The *measurements*, external and cranial, are given in millimeters. External measurements were read from specimen labels, are of adults unless otherwise noted, and always appear in the following sequence: total length; length of tail; length of hind foot; length of ear from notch; length of forearm (for bats only). Weights, usually given in grams, are, except as noted, of adults (females non-pregnant). Cranial measurements (also of adults unless stated otherwise) were taken by me with dial calipers in the manner described by Hall (1946:672-685) and Hooper (1952:9-11).

5. The *remarks* ordinarily include particular information concerning infra-

specific or other variation, along with such other notes as may apply only to a subspecies or to individual specimens.

6. The *records of occurrence* include both *specimens examined* and *additional records.*

Under *specimens examined,* the total number examined by me of each subspecies or monotypic species is given first, followed by a listing of the exact localities from which the specimens originated. County names are arranged alphabetically (location of Nebraska's 93 counties is shown in Fig. 82). Within each county, localities are listed from north to south; if two localities are at the same latitude the westernmost is listed first. A total of 10,339 specimens from Nebraska were examined in the course of this study. In addition, many specimens from other states were examined, including topotypes or typical specimens of kinds that do not have their type localities in Nebraska.

Unless otherwise noted, specimens examined are in the collection of the Museum of Natural History of The University of Kansas. Abbreviations designating specimens in other collections are as follows:

AMNH—American Museum of Natural History
CNHM—Chicago Natural History Museum
CM—Carnegie Museum
CSTC—Chadron (Nebraska) State Teachers College
HM—Hastings Museum, Hastings, Nebraska
MCZ—Museum of Comparative Zoology, Harvard
MSU—The Museum, Michigan State University
MVZ—Museum of Vertebrate Zoology, University of California
NGFPC—Nebraska Game, Forestation and Parks Commission
NSM—University of Nebraska State Museum
RV—Collection of Ralph Velich, Omaha, Nebraska
UC—Museum of Natural History, Union College, Lincoln, Nebraska
UF—Department of Biology, University of Florida
UI—Museum of Natural History, University of Illinois
UMMZ—Museum of Zoology, University of Michigan (including specimens formerly housed in the Cleveland Museum of Natural History)
UNDZ—Department of Zoology, University of Nebraska
UNM—Department of Biology, University of New Mexico
USNM—United States National Museum (including collections of the U. S. Biological Surveys)
WFR—Collection of W. F. Rapp, Crete, Nebraska
WSC—C. R. Connor Museum, Washington State College

Additional records are localities reported in the literature (or field notes) from which I have not examined specimens. Records in the literature no more precise than county ordinarily are not listed if I have examined specimens from at least one place within that county or if another record from the literature is from a precise locality within the same county. If reference to the same specimen(s) appears in more than one publication, as frequently is the case, my custom has been to cite the author who last examined the specimen(s) concerned.

The vast majority of place names cited in the accounts appear on any one of the commercial road maps available for Nebraska. All except nine appear on the 13 maps (nos. NK 13-6, 13-9, 14-4 through 14-12, 15-7, and 15-10)

that pertain to Nebraska in the "Western United States 1:250,000" series published by the U. S. Geological Survey. The nine that do not appear on maps of the USGS series are as follows:

Bull Canyon—canyon and intermittent creek in T. 19-20 N, R. 57-58 W, northwestern Banner County.

Child's Point—in Fontanelle Forest (see below), Sarpy County.

Fontanelle Forest—forest reserve in T. 14 N, R. 13-14 E, northeastern Sarpy County.

Homerville—town formerly in sec. 20, T. 6 N, R. 22 W, Gosper County.

Kelso—railroad siding in T. 24 N, R. 31 W, northeastern Hooker County.

London—town formerly in sec. 9, T. 5 N, R. 15 E, Nemaha County.

Myrtle—town formerly in sec. 22, T. 16 N, R. 29 W, Lincoln County.

Rockport—town formerly along Missouri River in T. 16 N, southeastern Washington County.

Turlington—town formerly on C. B. and Q. Railroad approximately 4 mi. E Syracuse, Otoe County.

Distribution maps accompanying accounts of the species show localities whence specimens have been examined by me or recorded by others, and my estimate of the area in the state where each species occurs. It is understood that a given species occupies only suitable habitats within the area of supposed occurrence. In plotting localities some were omitted from maps because undue crowding of symbols would have resulted; for the same reason, a few symbols are slightly offset on the maps. Also, in several instances localities were not plotted because the specimens from there were examined after maps were prepared. Localities not shown on maps are set in italic type in the lists of specimens examined and additional records. In general, a locality was not plotted if it fell within eight miles of another that was plotted. T. H. Swearingen made the finished distribution maps.

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Completion of this paper would have been impossible without the help, direct and indirect, of many persons. I am especially mindful of the contributions of those named below.

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CHECKLIST OF MAMMALS OF NEBRASKA

The 109 kinds (subspecies and monotypic species) of Nebraskan mammals are arranged in seven orders, 23 families and 59 genera, of which two families and five genera (five species) have been introduced from outside North America (marked by an asterisk in following checklist).

A list of 12 species that have not as yet been reported from Nebraska but that may occur in the state follows the accounts of species.

Order MARSUPIALIA—Marsupials

Family DIDELPHIDAE—Opossums

Didelphis marsupialis virginiana Kerr (Opossum) ..... p. 60

Order INSECTIVORA—Insectivores

Family SORICIDAE—Shrews

Sorex cinereus haydeni Baird (Masked Shrew) ..... p. 64
Blarina brevicauda brevicauda (Say) (Short-tailed Shrew) ..... p. 66
Blarina brevicauda carolinensis (Bachman) (Short-tailed Shrew) .... p. 69
Cryptotis parva parva (Say) (Least Shrew) ..... p. 71

Family TALPIDAE—Moles

Scalopus aquaticus caryi Jackson (Eastern Mole) ..... p. 74
Scalopus aquaticus machrinoides Jackson (Eastern Mole) ..... p. 76

Order CHIROPTERA—Bats

Family VESPERTILIONIDAE—Vespertilionid Bats

Myotis evotis evotis (H. Allen) (Long-eared Myotis) ..... p. 80
Myotis keenii septentrionalis (Trouessart) (Keen's Myotis) ..... p. 81
Myotis lucifugus carissima Thomas (Little Brown Myotis) ..... p. 82
Myotis lucifugus lucifugus (Le Conte) (Little Brown Myotis) ..... p. 83
Myotis subulatus subulatus (Say) (Small-footed Myotis) ..... p. 85
Myotis volans interior Miller (Long-legged Myotis) ..... p. 87
Lasionycteris noctivagans (Le Conte) (Silver-haired Bat) ..... p. 88
Pipistrellus subflavus subflavus (F. Cuvier) (Eastern Pipistrelle) .... p. 89

Eptesicus fuscus fuscus (Palisot de Beauvois) (Big Brown Bat) ..... p. 91
Eptesicus fuscus pallidus Young (Big Brown Bat) ..... p. 92
Lasiurus borealis borealis (Müller) (Red Bat) ..... p. 95
Lasiurus cinereus cinereus (Palisot de Beauvois) (Hoary Bat) ..... p. 96
Nycticeius humeralis humeralis (Rafinesque) (Evening Bat) ..... p. 98

Family MOLOSSIDAE—Free-tailed Bats

Tadarida brasiliensis mexicana (Saussure) (Brazilian Free-tailed Bat).. p. 101

Order LAGOMORPHA—Hares, Rabbits and Pikas

Family LEPORIDAE—Hares and Rabbits

**Oryctolagus cuniculus* (Linnaeus) (European Rabbit) ..... p. 331
Sylvilagus audubonii baileyi (Merriam) (Desert Cottontail) ..... p. 103
Sylvilagus floridanus mearnsii (J. A. Allen) (Eastern Cottontail) ..... p. 105
Sylvilagus floridanus similis Nelson (Eastern Cottontail) ..... p. 107
Lepus californicus melanotis Mearns (Black-tailed Jackrabbit) ..... p. 110
Lepus townsendii campanius Hollister (White-tailed Jackrabbit) ..... p. 113

Order RODENTIA—Rodents

Family SCIURIDAE—Squirrels and Allies

Tamias striatus griseus Mearns (Eastern Chipmunk) ..... p. 118
Eutamias minimus pallidus (J. A. Allen) (Least Chipmunk) ..... p. 119
Marmota monax bunkeri Black (Woodchuck) ..... p. 123
Spermophilus franklinii (Sabine) (Franklin's Ground Squirrel) ..... p. 125
Spermophilus richardsonii elegans Kennicott (Richardson's Ground Squirrel) ..... p. 128
Spermophilus spilosoma obsoletus Kennicott (Spotted Ground Squirrel). p. 129
Spermophilus tridecemlineatus pallidus J. A. Allen (Thirteen-lined Ground Squirrel) ..... p. 132
Spermophilus tridecemlineatus tridecemlineatus (Mitchill) (Thirteen-lined Ground Squirrel) ..... p. 134
Cynomys ludovicianus ludovicianus (Ord) (Black-tailed Prairie Dog).. p. 138
Sciurus carolinensis pennsylvanicus Ord (Gray Squirrel) ..... p. 143
Sciurus niger rufiventer É. Geoffroy St.-Hilaire (Fox Squirrel) ..... p. 147
Glaucomys volans volans (Linnaeus) (Southern Flying Squirrel) .... p. 150

Family GEOMYIDAE—Pocket Gophers

Thomomys talpoides cheyennensis Swenk (Northern Pocket Gopher) .. p. 153
Thomomys talpoides pierreicolus Swenk (Northern Pocket Gopher) ... p. 154
Geomys bursarius lutescens Merriam (Plains Pocket Gopher) ..... p. 156
Geomys bursarius majusculus Swenk (Plains Pocket Gopher) ..... p. 160

Family HETEROMYIDAE—Pocket Mice and Kangaroo Rats

Perognathus fasciatus fasciatus Wied-Neuwied (Olive-backed Pocket Mouse) ..... p. 165
Perognathus fasciatus olivaceogriseus Swenk (Olive-backed Pocket Mouse) ..... p. 165
Perognathus flavescens flavescens Merriam (Plains Pocket Mouse) .... p. 168
Perognathus flavescens perniger Osgood (Plains Pocket Mouse) ..... p. 170
Perognathus flavus piperi Goldman (Silky Pocket Mouse) ..... p. 172

Perognathus hispidus paradoxus Merriam (Hispid Pocket Mouse) .... p. 174
Perognathus hispidus spilotus Merriam (Hispid Pocket Mouse) ..... p. 175
Dipodomys ordii luteolus (Goldman) (Ord's Kangaroo Rat) ..... p. 179
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Onychomys leucogaster arcticeps Rhoads (Northern Grasshopper Mouse) ..... p. 208
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Sigmodon hispidus texianus (Audubon and Bachman) (Hispid Cotton Rat) ..... p. 214
Neotoma cinerea rupicola J. A. Allen (Bushy-tailed Woodrat) ..... p. 215
Neotoma floridana baileyi Merriam (Eastern Woodrat) ..... p. 217
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Microtus pennsylvanicus finitus Anderson (Meadow Vole) ..... p. 228
Microtus pennsylvanicus pennsylvanicus (Ord) (Meadow Vole) ..... p. 229
Microtus pinetorum nemoralis V. Bailey (Woodland Vole) ..... p. 234
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*Family MURIDAE—Old World Rats and Mice

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Zapus hudsonius pallidus Cockrum and Baker (Meadow Jumping Mouse) ..... p. 239

*Family CAPROMYIDAE—Nutria and Allies

**Myocastor coypus* (Molina) (Nutria or Coypu) ..... p. 335

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Erethizon dorsatum bruneri Swenk (Porcupine) ..... p. 242

Order CARNIVORA—Carnivores

Family CANIDAE—Coyote, Wolves and Foxes

Canis latrans latrans Say (Coyote) ..... p. 246
Canis lupus nubilus Say (Gray Wolf) ..... p. 251
Vulpes velox velox (Say) (Swift Fox) ..... p. 253
Vulpes vulpes regalis Merriam (Red Fox) ..... p. 256
Urocyon cinereoargenteus ocythous Bangs (Gray Fox) ..... p. 259

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Ursus americanus americanus Pallas (Black Bear) ..... p. 262
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Procyon lotor hirtus Nelson and Goldman (Raccoon) ..... p. 265

Family MUSTELIDAE—Weasels, Skunks and Allies

Mustela frenata longicauda Bonaparte (Long-tailed Weasel) ..... p. 268
Mustela frenata primulina Jackson (Long-tailed Weasel) ..... p. 271
Mustela frenata spadix (Bangs) (Long-tailed Weasel) ..... p. 272
Mustela nigripes (Audubon and Bachman) (Black-footed Ferret) .... p. 275
Mustela nivalis campestris Jackson (Least Weasel) ..... p. 277
Mustela vison letifera Hollister (Mink) ..... p. 280
Gulo luscus luscus (Linnaeus) (Wolverine) ..... p. 283
Taxidea taxus taxus (Schreber) (Badger) ..... p. 285
Spilogale putorius interrupta (Rafinesque) (Spotted Skunk) ..... p. 289
Mephitis mephitis hudsonica Richardson (Striped Skunk) ..... p. 292
Lutra canadensis interior Swenk (Otter) ..... p. 297

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Lynx canadensis canadensis Kerr (Lynx) ..... p. 303
Lynx rufus rufus (Schreber) (Bobcat) ..... p. 305

Order ARTIODACTYLA—Even-toed Ungulates

Family CERVIDAE—Wapiti, Deer and Allies

Cervus canadensis canadensis Erxleben (Wapiti) ..... p. 309
Odocoileus hemionus hemionus (Rafinesque) (Mule Deer) ..... p. 314
Odocoileus virginianus macrourus (Rafinesque) (White-tailed Deer) .. p. 318
**Dama dama* (Linnaeus) (Fallow Deer) ..... p. 336

Family ANTILOCAPRIDAE—Pronghorn

Antilocapra americana americana (Ord) (Pronghorn) ..... p. 323

Family BOVIDAE—Bovids

Bison bison bison (Linnaeus) (Bison) ..... p. 327
Ovis canadensis auduboni Merriam (Mountain Sheep) ..... p. 329

ACCOUNTS OF SPECIES

Key to Orders of Nebraskan Mammals

1. Hallux opposable, lacking a claw; marsupium present in females; incisors 5/4 ..... MARSUPIALIA, p. 58
1′. Hallux, if present, not opposable and bearing a claw; marsupium absent; incisors never more than 3/3 2
2(1′). Forelimbs modified for flight; fingers (which support a membraneous wing) longer than forearm ..... CHIROPTERA, p. 78
2′. Forelimbs not modified for flight; fingers shorter than forearm 3
3(2′). Upper incisors absent; feet provided with hooves ..... ARTIODACTYLA, p. 307
3′. Upper incisors present; feet provided with claws 4
4(3′). Tooth-rows continuous (no conspicuous diastema between teeth); canines present 5
4′. Tooth-rows having conspicuous diastema between incisors and cheek-teeth; canines absent 6
5(4). Canines approximately equal in size to adjacent teeth ..... INSECTIVORA, p. 62
5′. Canines conspicuously larger than adjacent teeth .. CARNIVORA, p. 244
6(4′). Ears of approximately same length as (or longer than) tail; incisors 2/1 ..... LAGOMORPHA, p. 101
6′. Ears conspicuously shorter than tail; incisors 1/1 .... RODENTIA, p. 115

Order MARSUPIALIA—Marsupials

Of the eight Recent families of marsupials, only one, Didelphidae, is known from North America. It is represented in the United States only by *Didelphis marsupialis.*

Family Didelphidae—Opossums and Allies

Didelphis marsupialis

Opossum

The opossum is widely distributed in Nebraska where it is one of the most abundant fur-bearers but, judging from the literature, the species was uncommon at the time of early settlement of the state and occurred only in the vicinity of the Missouri River and its immediate tributaries in southeastern Nebraska. It was not mentioned in the historical literature that I have seen on the period of early settlement when the animals would have been of value for their pelts and more especially for food. The species seems therefore to have increased in numbers in the state in the past hundred years and to have expanded its range northward and westward, utilizing as avenues of travel the deciduous riparian communities of river systems. The westernmost record of occurrence in Nebraska is a specimen from Alliance obtained on November 30, 1958. Cockrum (1952:35-37) suggested a similar westward expansion of range in Kansas. Rodeck (1952:69) reported the opossum as ". . . be-

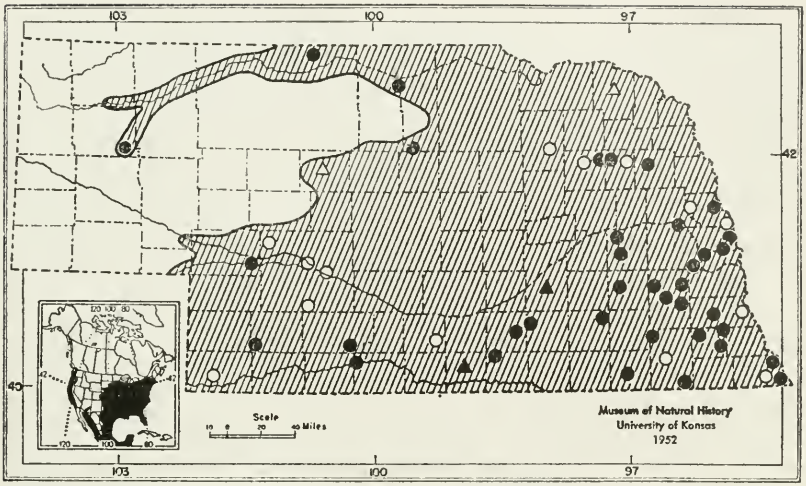

FIG. 5. Distribution of *Didelphis marsupialis virginiana* in Nebraska. Shaded area indicates probable extent of distribution. Symbols indicate records of occurrence as follows: solid symbols, specimens examined; open symbols, records from the literature; circles, precise localities; triangles, records known only to county.

coming more abundant in Colorado. A few years ago it was not even considered an inhabitant of the state, but a recent report shows it to be widespread over nearly all of Colorado east of the Divide."

Certainly man is in part responsible for the westward expansion of range of the opposum into the Great Plains. He is directly responsible through introduction of the species in certain places (Rees Heaton, for example, introduced "several pairs" along Medicine Creek at Curtis, Frontier County, about 1902 according to Swenk, MS). Indirectly, man created favorable deciduous habitats along water courses and elsewhere by the control of prairie fires and in some instances by plantings. Also, on vast areas he cultivated crops that provided opossums with a variety of foods, and he extirpated or reduced in numbers several large carnivores that would have preyed on opossums and that possibly in part limited their distribution to more heavily wooded areas.

Lewis and Clark, who traveled up the Missouri River in 1804 and back down in 1806, recorded the opossum as "found as high [on the Missouri] as the River platt [Platte]" (Thwaites, 1905:122). Later, James (1823:369), in the account of Long's expedition to the Rocky Mountains, reported the species from the Engineer Cantonment on the Missouri River in Washington County in the winter of 1819-20.

Aughey (1880:122) recorded *D. marsupialis* as "rather common in the wooded portion of the State," but listed no actual records. According to Swenk (1908:70) the opossum ". . . formerly was uncommon in this state and found only in the extreme southeastern portion, but of recent years it has extended its range along the wooded tributaries of the Missouri until it is now present along nearly the whole eastern edge of the state. In the valleys of the Blue, Platte and Elkhorn it penetrates into the Prairie region for a hundred miles or more. The most northwestern record is from Norfolk, where several have been captured in recent years. . . ." Cary (MS) reported the species as taken in the vicinity of Norfolk in 1896 and remarked that "previous to that year [it was] never heard of in that section."

The opossum may have extended its range westward in the Republican River Valley of southern Nebraska in advance of westward extension in the northern and central parts of the state. Swenk (MS) recorded the species on Medicine Creek, a tributary of the Republican, in southern Lincoln County as early as 1884. The earliest known record from the northern part of the same county, in the Platte River drainage, is of an individual captured along Birdwood Creek "about 1905" (Swenk, MS). Few reports are available from the interior of the Sand Hills and the opossum seemingly has been less successful there than elsewhere in moving along riparian communities. Smith (1958:59), for example, reported the species as rare in Thomas County and suggested that it reached the county along the Middle Loup River "about 1930."

Large litters, ability to withstand severe injury and frost-bite, and omnivorous food habits contribute to the remarkable success of this animal. It evidently is more abundant in Nebraska now than at any time in its Recent history. Females ordinarily breed in February and March; some may breed a second time in late spring. Reynolds (1952:229) reported an average of 8.6 young per litter for 23 litters from eastern Nebraska.

Didelphis marsupialis virginiana Kerr

Didelphis virgianiana Kerr, The animal kingdom . . ., p. 193, 1792 (type locality, Virginia); Swenk, Proc. Nebraska Acad. Sci., 8:70, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:14, September, 1908.

Didelphis marsupialis virginiana, Chapman, Bull. Amer. Mus. Nat. Hist., 6:334, November 30, 1894 [name-combination applied to Floridian specimens, now the subspecies *D. m. pigra,* but applied prior to the original description of *pigra* when opossums from everywhere in the eastern United States were referred to the one subspecies, *virginiana*].

Didelphius [sic] virginiana, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Didelphis Virginiana, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Didelphis virginianus virginianus, Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 407, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:17, March 1, 1919; Swenk, Nebraska Blue Book, p. 479, December, 1920.

Didelphis virginiana virginiana, Jones and Webb, Jour. Mamm., 30:313, August 17, 1949.

D[idelphis]. m[arsupialis]. virginiana, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Common in eastern part of state, west certainly to Box Butte County. See Fig. 5.

Measurements.—External measurements of a male and two females from 2 mi. NE Ashland are, respectively: 748, 704, 693; 310, 293, 290; 69, 65, 62; 55, 51, 47. Corresponding respective measurements of a male and female from Lancaster County are: 727, 676; 317, 294; 68, 63; 46, 47. A male from Gage County weighed 4 lbs. 9 oz., a female from Keith County, 3½ lbs. Hamilton (1958:6) recorded the heaviest male and female examined from New York as weighing 11 lbs. 2 oz., and 7 lbs. 4 oz., respectively.

Cranial measurements of two males and three females from Butler and Lancaster counties are, respectively: condylobasal length, 119.9, 118.0, 115.2, 111.3, 108.5; zygomatic breadth, 67.8, 66.6, 64.5, 60.1, 59.4; interorbital breadth, 26.1, 24.1, 24.2, 21.0, 21.5; postorbital breadth, 11.5, 10.9, 12.4, 11.1, 11.4; length of nasals, 55.4, 56.7, 53.4, 50.9, 52.2; palatal length, 71.5, 69.4, 69.5, 68.3, 65.7; length of P1-M4, 39.1, 37.8, 39.0, 38.5, 38.0.

Records of occurrence.—Specimens examined, 131, as follows: ADAMS COUNTY: *Hastings,* 2 (1 HM); 5 mi. S Hastings, 4 (HM). BOX BUTTE COUNTY: Alliance, 1 (CSTC). BROWN COUNTY: Long Pine Creek, 1 (AMNH). BUTLER COUNTY: 3 mi. S Bellwood, 1; *4 mi. S, 4 mi. W David City,* 1; 4 mi. E Rising City, 2. CHERRY COUNTY: W of Crookston, 1 (NSM). CLAY COUNTY: Inland, 7 (HM). CUMING COUNTY: Beemer, 1 (USNM). DOUGLAS COUNTY: Omaha, 1 (NSM); Ralston, 1 (RV). FILLMORE COUNTY: Exeter, 1 (MVZ). FRANKLIN COUNTY: no specific locality, 1 (NSM). FRONTIER COUNTY: 15 mi. SE Stockville, 1 (NSM). FURNAS COUNTY: Cambrige, 1 (NSM); *Republican River, 1 mi. E Cambridge,* 2 (NSM). GAGE COUNTY: 2 mi. W Clatonia, 1 (NSM); 1 mi. S, 1 mi. W Barnston, 1; *2 mi. S, 1½ mi. E Barnston,* 3. HAMILTON COUNTY: no specific locality, 1 (HM). HAYES COUNTY: 4 mi. E Wauneta, 1 (NSM). JEFFERSON COUNTY: Fairbury, 1 (NSM). JOHNSON COUNTY: 6 mi. ENE Cook, 1 (NSM); *Cook,* 4 (NSM); *vicinity Cook,* 2 (NSM); Sterling, 3 (NSM); *4 mi. ENE St. Mary,* 1 (NSM); *St. Mary,* 1 (NSM); 6 mi. E Tecumseh, 1 (NSM); *no specific locality,* 13 (NSM). KEITH COUNTY: Paxton, 1 (NSM). LANCASTER COUNTY: 1 mi. E Waverly, 1 (NSM); Malcolm, 1 (NSM); Lincoln, 15 (1 NGFPC, 4 NSM, 7 UC, 3 UNDZ); *vicinity Lincoln,* 1 (NSM); *3 mi. W Lincoln,* 1 (NSM); *3 mi. E Lincoln,* 1 (UC); *1 mi. S Lincoln,* 1 (UC); *3½ mi. S, 2 mi. E Lincoln,* 1 (UC); *6 mi. S Lincoln,* 1 (UC); 4 mi. NNE Bennet, 2 (NSM); *no specific locality,* 1 (UNDZ). MADISON COUNTY: Elkhorn River, 2 mi. E Norfolk, 1. OTOE COUNTY: 2 mi. S Syracuse, 1 (NSM). RICHARDSON COUNTY: 4 mi. E Barada, 15; 2 mi. S, 4 mi. E Rulo, 1. ROCK COUNTY: Skull Creek, 30 mi. S Bassett, 3 (AMNH); *Johnson Ranch, Skull Creek,* 2 (AMNH). SARPY COUNTY: 2 mi. N Gretna, 1 (NSM). SAUNDERS COUNTY: 5 mi. S Fremont, 1 (NGFPC); *2 mi. NE Ashland,* 4 (NSM); 2 mi. W Ashland, 1 (NSM); *Platte River, near Ashland,* 5 (NSM). SEWARD COUNTY: 5 mi. W Seward, 1 (UMMZ); *3 mi. S, 2 mi. E Seward,* 1 (UNDZ). STANTON COUNTY: *7 mi. E Norfolk,* 1; 1 mi. S, 7 mi. E Norfolk, 1. WASHINGTON COUNTY: ¼ mi. N Blair, 1 (UC). WEBSTER COUNTY: Bladen, 1 (AMNH).

Additional records (Swenk, MS, unless otherwise noted): ANTELOPE COUNTY: Neligh. CEDAR COUNTY: no specific locality (Cary, MS). DODGE COUNTY: *Fremont*. DUNDY COUNTY: Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks (Jones, field notes). GAGE COUNTY: Beatrice (Cary, MS). LINCOLN COUNTY: Birdwood Creek; 2 mi. E North Platte; Maxwell; Medicine Creek, southern part of county. MADISON COUNTY: *Norfolk* (Swenk, 1908:70); Battle Creek. OTOE COUNTY: Nebraska City (Cary, MS). PHELPS COUNTY: Funk. RICHARDSON COUNTY: Falls City (Cary, MS); *vicinity Rulo* (Jones and Webb, 1949:317). STANTON COUNTY: Pilger (Cary, MS). THOMAS COUNTY: no specific locality (Smith, 1958:59). WASHINGTON COUNTY: Fontanelle; Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823: 369). Fichter's (1944:18) map that records opossums taken in the 1942 trapping season has been taken into account in preparing Fig. 5.

Order INSECTIVORA—Insectivores

Four genera of insectivores, each represented by a single species, occur in Nebraska. One additional genus (*Microsorex*) and at least one additional species of *Sorex* may be found to occur in the state. McDowell (1958) would apply the ordinal name Lipotyphla to the Recent families of insectivores.

KEY TO NEBRASKAN INSECTIVORES

1. Total length usually more than 140; forefeet modified for digging; zygomatic arch present; condylobasal length more than 30 (family Talpidae) ..... *Scalopus aquaticus* p. 73
1′. Total length usually less than 140; forefeet not modified for digging; zygomatic arch absent; condylobasal length less than 26 (family Soricidae) 2
2(1′). Tail long, more than 30 per cent of total length ..... *Sorex cinereus* p. 62
2′. Tail short, less than 25 per cent of total length 3
3(2′). Total length more than 100; condylobasal length more than 20; usually 32 teeth (usually five unicuspids on either side of upper jaw) ..... *Blarina brevicauda* p. 65
3′. Total length less than 100; condylobasal length less than 17; 30 teeth (four unicuspids on either side of upper jaw) ..... *Cryptotis parva* p. 70

Family SORICIDAE—Shrews

Sorex cinereus

Masked Shrew

The masked shrew is locally common, most frequently in marshy areas and lush riparian associations, in the northern part of the state south to the Platte River drainage. I know of only one record—a specimen obtained 5 mi. E Rising City on May 31, 1956—from south of the Platte River drainage and this from but a few miles south of the divide between the drainages of the Platte and Blue rivers. No specimens are presently available from the vicinity of the Platte River proper in extreme eastern Nebraska nor from the South Platte River and Lodgepole Creek in the southern part of the Panhandle and possibly the species does not occur in these areas. Similarily, no specimens are available from the Pine Ridge

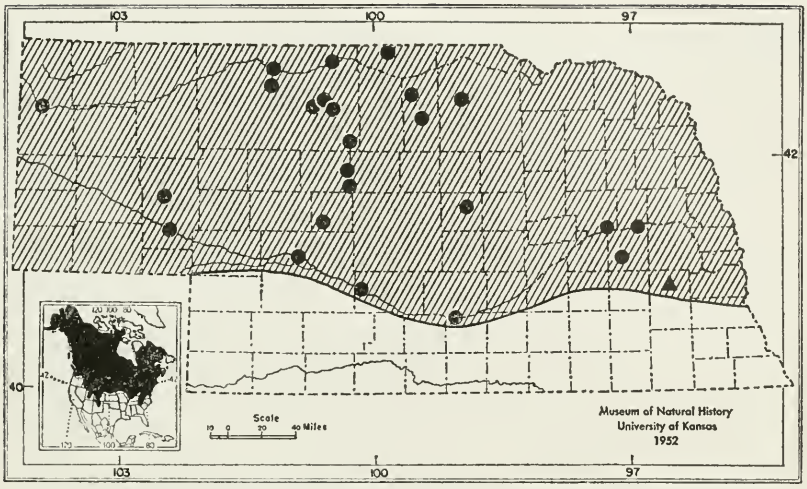

FIG. 6. Distribution of *Sorex cinereus haydeni* in Nebraska. For explanation of symbols see Fig. 5.

area of extreme northwestern Nebraska, but I would guess that the masked shrew occurs there.

In the eastern part of its range in Nebraska *Sorex cinereus* is often associated with *Blarina brevicauda.* I know of no instance, however, in which masked shrews have been taken in the state with *Cryptotis parva,* although the two species are sympatric over a large area. Perhaps competition between these two small shrews tends eventually to exclude one from places inhabited by the other. However, *Cryptotis* is more an animal of upland habitats than *Sorex* and additional collecting may show that the two kinds live in the same areas but in different ecological niches. From *C. parva, S. cinereus* can be distinguished easily by longer tail, blackish or dark brown upper parts (rather than pale brown or olive brown) in summer pelage, and 32 (5 unicuspids on each side above) rather than 30 teeth.

Van den Brink (1953) argued a Holartic distribution for the masked shrew and relegated *Sorex cinereus* to synonymy under the previously named *Sorex caecutiens.* He, therefore, employed the name-combination *Sorex caecutiens haydeni* (p. 104) for the subspecies that occurs in Nebraska. I have not had the opportunity to review critically Van den Brink's findings and consequently here retain the specific name *cinereus* following Hall and Kelson (1959:27).

A female from Thomas County taken on July 9, 1957, was lactating. Asdell (1946:67) recorded the number of young as 4-10.

Sorex cinereus haydeni Baird

Sorex haydeni Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1): 29, July 14, 1858 (type locality restricted to Ft. Union, just west of confluence of Missouri and Yellowstone rivers, Williams Co., North Dakota, by Merriam, N. Amer. Fauna, 10:60, December 31, 1895).

Sorex cinereus haydeni, Jackson, Jour. Mamm., 6:56, February 9, 1925; Jackson, N. Amer. Fauna, 51:51, July 24, 1928; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:481, April 21, 1954; Hall and Kelson, The mammals of North America, p. 27, March 31, 1959.

S[orex]. Haydeni, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880 (part).

S[orex]. Cooperi, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880 (part).

Sorex personatus haydeni, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:257, November, 1896; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:29, October, 1936.

Sorex personatus, Swenk, Proc. Nebraska Acad. Sci., 8:133, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:77, September, 1908.

Sorex p[ersonatus]. haydeni, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Sorex cinereus, Jones, Nebraska Bird Rev., 20:11, January, 1952.

S[orex]. c[inereus]. haydeni, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Northern part of state, south to Platte River drainage; known south of Platte drainage only from one locality in Butler County. See Fig. 6.

External measurements.—Measurements of a male and three females, all second year animals, from 12 mi. NNW Springview are, respectively: 94, 95, 96, 97; 35, 34, 35, 34; 13, 11, 12, 12; 6, 7, 7, 7. Average and extreme measurements of six young of the year (two males, four females) from Holt and Thomas counties are: 93.0 (88-97); 37.0 (36-38); 11.7 (11-12). For cranial measurements see Table 3.

A male and two females from 1 mi. W Halsey weighed 3.8, 4.7, and 3.4 grams, respectively.

Remarks.—Nebraskan specimens vary considerably individually in cranial dimensions. In external measurements, however, and especially in color they are fairly uniform when specimens of equal age are compared. Fresh winter pelage (seen in specimens taken in November and December) is pale grayish brown dorsally. Summer pelage of first year animals is more or less uniformly dark brown dorsally, whereas summer pelage of second year shrews is blackish brown middorsally, brownish on the sides and whitish below, imparting an over-all tricolored appearance.

Aughey (1880:122) listed four shrews of the genus *Sorex* as occurring in Nebraska (*"Sorex pachyurus, S. richa[rdsonii], S.*

Cooperi, S. Haydeni"). Almost certainly this resulted from guesswork; probably he projected the known ranges of the recognized "species" of the day. The last two of these names are included in the synonymy above (*Sorex cooperi* Bachman is currently regarded as a synonym of *Sorex cinereus cinereus*). The first two names, *pachyurus* and *richardsonii*, fall in the synonymy of the species *S. arcticus*, which does not occur in Nebraska.

Records of occurrence.—Specimens examined, 92, as follows: BUTLER COUNTY: 4 mi. N, ½ mi. E Octavia, 2; 5 mi. E Rising City, 1. CHERRY COUNTY: *Ft. Niobrara Nat'l Wildlife Refuge*, 1 (NSM); 3 mi. SSE Valentine, 2; Niobrara River, 10 mi. S Cody, 1 (USNM); Two Mile Lake (sec. 12, R. 34 W, T. 31 N), 3 (2 NSM, 1 USNM); *Watt's Lake, Valentine Nat'l Wildlife Refuge*, 2; Hackberry Lake, Valentine Nat'l Wildlife Refuge, 2 (1 UMMZ); *Dewey Lake, Valentine Nat'l Wildlife Refuge*, 6; Kennedy, 1 (USNM); Pony Lake, Valentine Nat'l Wildlife Refuge, 1 (CNHM); Wendler's Pond, 30 mi. S Wood Lake, 9 (CNHM). DAWSON COUNTY: ½ mi. S Gothenburg, 2. DAWES COUNTY: *20 mi. S Chadron*, 1 (CSTC). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge, 1 (USNM); ½ mi. S Oshkosh, 2. HOLT COUNTY: 1 mi. S Atkinson, 3. KEARNEY COUNTY: 1¾ mi. S Kearney, 1. KEYA PAHA COUNTY: 12 mi. NNW Springview, 4. LANCASTER COUNTY: no specific locality, 1 (UNDZ). LINCOLN COUNTY: 2 mi. N, 5 mi. W North Platte, 2720 ft., 1; *2 mi. N North Platte*, 9. LOGAN COUNTY: 1 mi. NE Stapleton, 15. PLATTE COUNTY: Columbus, 1 (UNDZ). ROCK COUNTY: Bassett, 4 (AMNH); Perch, 9 (AMNH). SIOUX COUNTY: Agate, 4600 ft., 1. THOMAS COUNTY: 1 mi. W Halsey, 3; Dismal River, 1 mi. W Thomas-Blaine Co. line, 1 (NGFPC). VALLEY COUNTY: 2½ mi. N Ord, 2.

Additional record: CHERRY COUNTY: *Center Lake, Valentine Nat'l Wildlife Refuge* (Jones, 1952:11).

Blarina brevicauda

Short-tailed Shrew

The short-tailed shrew occurs in a variety of habitats in eastern Nebraska and is one of the commonest small mammals in some places. In the western part of its range in the state this shrew tends to be restricted in occurrence to riparian communities, although it frequently is no less abundant therein than in similar habitats farther eastward. The known western limit of range of the species in the central Great Plains is along the Republican River just west of the Nebraska-Colorado border in Yuma County, Colorado.

Two subspecies, *B. b. brevicauda* and the smaller *B. b. carolinensis*, occur in Nebraska. The narrow zone of secondary intergradation between these two races and its probable origin are discussed on pp. 28-30.

At the latitude of Nebraska, short-tailed shrews may breed twice yearly, once in spring and once in late summer. Each of two females taken 3 mi. SE Blair on April 24, 1958, contained 4 embryos. Of two pregnant females collected ¼ mi. W Homestead Na-

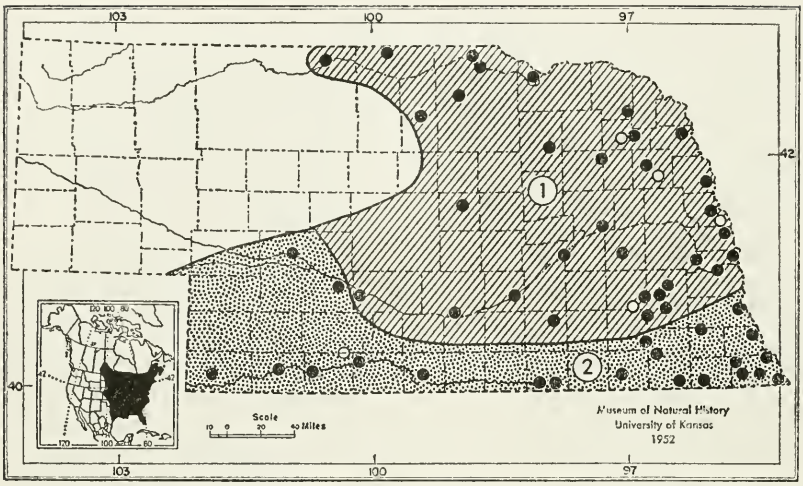

FIG. 7. Distribution of *Blarina brevicauda* in Nebraska. 1. *B. b. brevicauda.* 2. *B. b. carolinensis.* For explanation of symbols see Fig. 5.

tional Monument on May 8, 1959, one contained 6 embryos and the other 7. A female still in juvenal pelage, therefore a young of the year, obtained on May 1, 1958, 1 mi. S Beemer, contained 5 embryos. Lactating females have been taken in May (Gage County), July (Cedar County and Wayne County), and August (Dundy County).

Blarina brevicauda brevicauda (Say)

Sorex brevicaudus Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:164, 1823 (type locality, Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun, Washington Co.], Nebraska).

Blarina brevicauda, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):42, July 14, 1858; Merriam, N. Amer. Fauna, 10:10, December 31, 1895; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:257, November, 1896; Swenk, Proc. Nebraska Acad. Sci., 8:134, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:78, September, 1908.

B[larina]. talpoides, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880 (part).

B[larina]. brevicauda, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880 (part).

Blarina brevicauda brevicauda, Swenk, Nebraska Blue Book, p. 854, 1915 (part); Swenk, Nebraska Blue Book, p. 411, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 483, December, 1920 (part); Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:24, October, 1936; Whelan, Trans. Kansas Acad. Sci., 39:365, 1937; Bole and Moulthrop, Sci. Publ., Cleveland Mus. Nat. Hist., 5:103, September 11, 1942; Jones and Findley, Trans. Kansas Acad. Sci., 57:210, August 2, 1954; Findley

and Van Gelder, Jour. Mamm., 36:452, August 30, 1955; Hall and Kelson, The mammals of North America, p. 52, March 31, 1959 (part); Jones and Glass, Southwestern Nat., 5:139, November 1, 1960.

B[larina]. b[revicauda]. brevicauda, Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:482, April 21, 1954; Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Northern and central parts of state, west certainly to Cherry and Dawson counties, south certainly to Clay and Saline counties. See Fig. 7.

External measurements.—Average and extreme measurements of 18 specimens (11 males, seven females) from the vicinity of Blair are: 132.4 (125-141); 26.4 (23-31); 17.0 (16-18). For cranial measurements see Table 3. A male and two females from Lincoln weighed 29.5, 23.7, and 23.4 grams, respectively.

Remarks.—From *Blarina brevicauda carolinensis,* geographically adjacent to the south in Nebraska, *B. b. brevicauda* (the largest subspecies of the species) differs in being significantly larger externally and especially cranially (see measurements). The two subspecies do not differ in color.

I have seen no specimens from Nebraska that can be described as exactly intermediate between *brevicauda* and *carolinensis.* Specimens here referred to *brevicauda* from Louisville and some of those from the vicinity of Lincoln are smaller externally and average slightly smaller cranially than topotypes of that subspecies and therefore approach *carolinensis.* Similarly, specimens here assigned to *carolinensis* from ¼ mi. W Homestead National Monument and from the vicinity of DeWitt, in Gage and Saline counties, average slightly larger externally and cranially than other specimens of that subspecies from Nebraska. Two specimens from Crete that lack skulls have small external dimensions, but are referred to *brevicauda* because four specimens from 4 mi. NE Crete that do have skulls are typical of that subspecies.

Cary (1902:69), in a paper entitled "Some general remarks upon the distribution of life in northwest Nebraska," recorded "*Blarina* sp." in a list of mammals restricted to the Transition Life-zone in Sioux County. Subsequently, Swenk (1908:134) listed *Blarina brevicauda* as occurring in Sioux County, presumably on the basis of Cary's report. Inasmuch as Cary's paper was submitted to an ornithological journal, an annotated list of mammals in his original manuscript was not published. This annotated list is preserved, however, in Swenk's collection of unpublished notes on Nebraskan mammals (Swenk, MS), and inspection reveals that the report of *Blarina* was not based on actual specimens but on "signs." Whatever these "signs" may have denoted, I am reasonably sure it was

not *Blarina* for insofar as I know the species occurs nowhere in northwestern Nebraska. Jones and Findley (1954:210) recorded *B. b. brevicauda* from Crescent Lake National Wildlife Refuge, Garden County, citing Imler (1945:272) as the source of the record. Subsequently, I (1957:274) mentioned Garden County as the westernmost record for the species in state. Perusal of Imler's paper in connection with the present report fails to reveal mention of the species on p. 272 or anywhere else therein! Actually, the western limit of distribution of the species in the state is in Cherry, Lincoln and Dundy counties, and shrews from the last two counties are referable to *B. b. carolinensis.*

The type locality of *B. b. brevicauda* (and incidently also of *Cryptotis parva parva, Canis latrans latrans,* and *Canis lupus nubilus*), the Engineer Cantonment where Major S. H. Long and his command, including the naturalist Thomas Say, spent the winter of 1819-1820, has been located as various places along the Missouri River by different authors (see discussion in Jackson, 1951:260-261). James (1823:146), botanist, geologist, and surgeon for the expedition, and its official chronicler, entered the following concerning this locality: "The position selected for the establishment of winter quarters for the exploring party, was on the west bank of the Missouri [River], about half a mile above Fort Lisa, five miles below Council Bluff [of Lewis and Clark, *not* the city of Council Bluffs, Iowa], and three miles above the mouth of Boyer's river. At this place we anchored on the 19th September 1819. . . ." This would locate the Engineer Cantonment in Washington County, Nebraska, about five miles north of the Douglas-Washington county line at a place approximately two miles east of the present village of Ft. Calhoun.

Records of occurrence.—Specimens examined, 174, as follows: ANTELOPE COUNTY: Neligh, 7 (6 NSM, 1 USNM). BOYD COUNTY: 5 mi. NNW Spencer, 1; 5 *mi. S, 2 mi. E Spencer,* 2. BUFFALO COUNTY: Kearney, 2 (USNM). BURT COUNTY: 1 mi. E Tekamah, 2. BUTLER COUNTY: 4 mi. E Rising City, 2; 5 *mi. E Rising City,* 4. CASS COUNTY: Louisville, 5. CEDAR COUNTY: 4 mi. SE Laurel, 7. CHERRY COUNTY: Valentine, 3 (USNM); *4 mi. E Valentine,* 1; *3 mi. SSE Valentine,* 1; *3 mi. S Valentine,* 1. CLAY COUNTY: Saronville, 1 (UF). CUMING COUNTY: 1 mi. S Beemer, 1. DAWSON COUNTY: 5 mi. S Gothenburg, 1. DOUGLAS COUNTY: North Omaha, 1 (NSM). HALL COUNTY: 6 mi. S Grand Island, 3. HOLT COUNTY: 6 mi. N Midway, 1; 1 mi. S Atkinson, 2 (1 NSM). KEYA PAHA COUNTY: 12 mi. NNW Springview, 1. KNOX COUNTY: 3 mi. W Niobrara, 2; *1 mi. SE Niobrara,* 1. LANCASTER COUNTY: 12 mi. N Lincoln, 1 (UC); T. 10 N, R. 5 E, S of Malcolm, 1 (NSM); *within 5 mi. Lincoln,* 42 (1 HM, 1 NGFPC, 7 NSM, 23 UC, 5 UNDZ); 6 mi. S Lincoln, 4 (UC); *½ mi. W Jamaica Jct.,* 1 (UC); *no specific locality,* 1 (UNDZ). PLATTE COUNTY: *2 mi. N Columbus,* 1 (UNDZ); *2 mi. NE Columbus,* 1 (UNDZ); Columbus, 3 (USNM); *3½ mi. E Columbus,* 1 (UNDZ). POLK COUNTY: 15 mi. W Osceola, 2. ROCK COUNTY: Perch, 4 (AMNH). SALINE COUNTY: 4 mi. NE Crete, 4; *Crete,* 2 (WFR). SARPY

COUNTY: Ft. Crook, 1 (AMNH); *1 mi. W Meadow,* 3. SAUNDERS COUNTY: 2 mi. NE Ashland, 4. SEWARD COUNTY: 1 mi. N Pleasant Dale, 4. STANTON COUNTY: 4½ mi. SSE Norfolk ("on county line"), 1. THURSTON COUNTY: 1 mi. S Winnebago, 3. VALLEY COUNTY: 2½ mi. N Ord, 2. WASHINGTON COUNTY: Blair, 9 (8 UMMZ, 1 USNM); *1 mi. E Blair,* 2; *3 mi. SE Blair,* 2; *6 mi. SE Blair,* 8. WAYNE COUNTY: *½ mi. W Wayne,* 4; Wayne, 10. County unknown: *Little Blue River,* 1 (USNM).

Additional records: CUMING COUNTY: West Point (Swenk, 1908:134). DOUGLAS COUNTY: *Omaha* (Swenk, 1908:134). LANCASTER COUNTY: *9 mi. NW Lincoln* (Whelan, 1937:365). SEWARD COUNTY: Milford (Swenk, MS). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], the type locality. WAYNE COUNTY: 4 mi. SE Carroll (Jones, 1949*b*:5).

Blarina brevicauda carolinensis (Bachman)

Sorex carolinensis Bachman, Jour. Acad. Nat. Sci. Philadelphia, 7:366, 1837 (type locality, eastern South Carolina).

Blarina brevicauda carolinensis, Merriam, N. Amer. Fauna, 10:13, December 31, 1895; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:481, April 21, 1954; Jones and Findley, Trans. Kansas Acad. Sci., 57:210, August 2, 1954; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:388, May 12, 1958; Hall and Kelson, The mammals of North America, p. 53, March 31, 1959; Jones, Jour. Mamm., 41:132, February 20, 1960; Jones and Glass, Southwestern Nat., 5:139, November 1, 1960.

Blarina brevicauda brevicauda, Swenk, Nebraska Blue Book, p. 854, 1915 (part); Swenk, Nebraska Blue Book, p. 411, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 483, December, 1920 (part); Jones and Webb, Jour. Mamm., 30:313, August 17, 1949; Hall and Kelson, The mammals of North America, p. 53, March 31, 1959 (part).

B[larina]. b[revicauda]. carolinensis, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Southern part of state, north along Missouri River certainly to Otoe County, north in western part of range to Platte River drainage in Lincoln County. See Fig. 7.

External measurements.—Average and extreme measurements of 20 specimens (seven males, 12 females, one of unknown sex) from Richardson County are: 112.3 (103-121); 22.6 (19-25); 14.4 (13-16). Corresponding measurements of 20 specimens (11 males, nine females) from 5 mi. N, 2 mi. W Parks are: 111.1 (106-117); 24.2 (22-27); 14.6 (13-16). For cranial measurements see Table 3.

Average (and extremes) weight in grams of seven specimens (two males, five females) from the Richardson County series was 14.6 (13.4-15.5), and that of eight specimens (four males, four females) from the series from 5 mi. N, 2 mi. W Parks was 15.0 (13.7-16.3).

Remarks.—For comparisons with *Blarina brevicauda brevicauda,* geographically adjacent to the north in Nebraska, see account of that subspecies.

The genus *Blarina* is in need of taxonomic revision. When such a revision is undertaken it may be found, as Bryan P. Glass and I pointed out (Jones and Glass, 1960:140), that the subspecific name *carolinensis* should be restricted to the uniformly dark, small populations of the species along the southern Atlantic and Gulf coasts. In that event, the name *Blarina brevicauda hulophaga* Elliot, 1899 (type locality, east of Dougherty, Murray Co., Oklahoma), would

be available for shrews from along the western edge of the range of the species from Oklahoma to southern Nebraska. The external and cranial measurements of Nebraskan *carolinensis* do not differ appreciably from those of shrews from Dorchester, Maryland, assigned to *carolinensis* by Bole and Moulthrop (1942:108), nor, for that matter, from the measurements of the type specimen of *Blarina brevicauda kirtlandi* Bole and Moulthrop (*op. cit.*:100), a subspecies characterized by its describers as constituting ". . . the central stock of the species, being intermediate in its characters and geographical distribution" (p. 101).

Except for the previously mentioned specimens from ¼ mi. W Homestead National Monument and those from the vicinity of DeWitt in Gage and Saline counties, all the shrews from Nebraska here assigned to *carolinensis* are fairly uniform in external and cranial dimensions. No appreciable differences in color were noted in any of the specimens examined.

Records of occurrence.—Specimens examined, 123, as follows: DUNDY COUNTY: Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, 44 (1 NGFPC). FURNAS COUNTY: 5 mi. W Holbrook, 1 (UI). GAGE COUNTY: *1 mi. SE DeWitt*, 1; ¼ mi. W Homestead Nat'l Monument, 11; 1 mi. S, 1 mi. W Barnston, 1; *1½ mi. S, 2 mi. E Barnston*, 2; *2 mi. S, ½ mi. E Barnston*, 3. HARLAN COUNTY: 1 mi. W Alma, 2; *1 mi. S Alma*, 1. HITCHCOCK COUNTY: Republican River, Trenton, 5. JEFFERSON COUNTY: 7 mi. S, 2 mi. W Fairbury, 1. JOHNSON COUNTY: 1 mi. S, 1½ mi. E Burr, 1. LINCOLN COUNTY: 2 mi. N, 5 mi. W North Platte, 2720 ft., 1; *2 mi. N North Platte*, 5; Conroy Canyon, SW corner sec. 4, T. 11 N, R. 27 W (5 mi. S, 2½ mi. W Brady), 1 (NSM). NEMAHA COUNTY: *Peru*, 1 (NSM); 3 mi. S, 1½ mi. E Peru, 1. NUCKOLLS COUNTY: 2 mi. WSW Superior, 1; 1 mi. SSW Hardy, 1. OTOE COUNTY: 1 mi. SE Nebraska City, 2; *3 mi. S, 2 mi. E Nebraska City*, 5. PAWNEE COUNTY: 4 mi. S, 8 mi. W Pawnee City, 1. RED WILLOW COUNTY: McCook, 1 (NSM). RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 2; 4 mi. E Barada, 5; 2 mi. N Falls City, 5; *6 mi. W Falls City*, 2; 3½ mi. S, 1 mi. W Dawson, 9; *8 mi. S, 1 mi. E Dawson*, 2; ½ mi. S, 1½ mi. W Rulo, 2; *2 mi. S, 4 mi. E Rulo*, 1. SALINE COUNTY: 1½ mi. W DeWitt, 2.

Additional record: RED WILLOW COUNTY: 9 mi. NE Bartley (Jones, 1949*b*:5).

Cryptotis parva

Least Shrew

The distribution of the least shrew is more extensive in southern Nebraska than in the northern part of the state. The species occurs all the way to the Colorado boundary along the Platte and Republican river systems, reaching the westernmost extent of its range in northeastern Colorado. In northern Nebraska the westernmost record is in Cherry County along Minichaduza Creek, a tributary of the Niobrara River. The range of *Cryptotis parva* in Nebraska is sympatric to a large degree with that of the short-tailed shrew, *Blarina brevicauda*. *Cryptotis* can be distinguished from *Blarina*

by the differences mentioned in the key and also by brownish (rather than grayish black) upper parts, paler venter, and in that the unicuspids gradually decrease in size posteriorly (the first two are large and the last two small in *Blarina*).

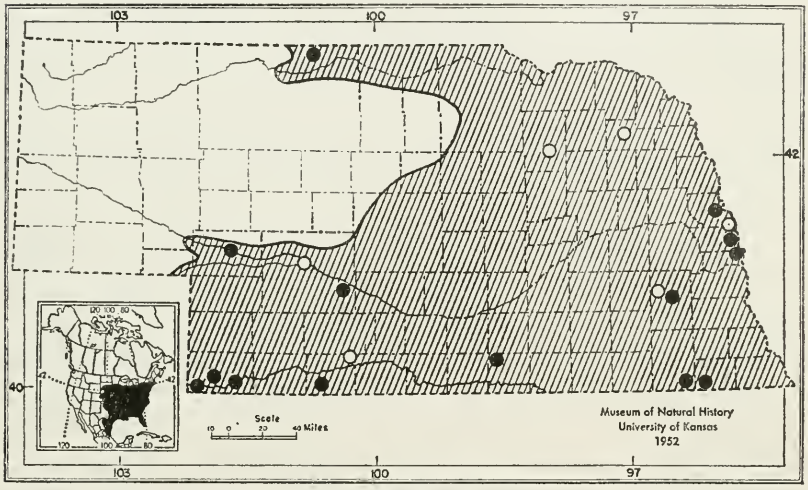

FIG. 8. Distribution of *Cryptotis parva parva* in Nebraska. For explanation of symbols see Fig. 5.

I have rarely found this diminutive shrew to be common in the state and have never taken more than one in the same trap line. Perhaps more would be captured if small, especially baited traps were used regularly in field work. A number have been taken in the vicinity of Lincoln in pitfalls made primarily for terrestrial arthropods. Also, I remember several times, especially in the summer of 1943, when many were found in window wells of houses on the southeastern edge of Lincoln.

Asdell (1946:67) recorded the number of young as from 3-6; the species is polyestrous.

Cryptotis parva parva (Say)

Sorex parvus Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:163, 1823 (type locality, Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun, Washington Co.], Nebraska).

Cryptotis parva, Miller, Bull. U. S. Nat. Mus., 79:24, December 31, 1912; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Whelan, Trans. Kansas Acad. Sci., 39:365, 1937.

B[larina]. exilpes, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Blarina parva, Merriam, N. Amer. Fauna, 10:17, December 31, 1895; Swenk, Proc. Nebraska Acad. Sci., 8:134, September, 1908; Swenk, Univ. Nebraska Studies, 89:78, September, 1908.

Cryptotis parva parva, Bole and Moulthrop, Sci. Publ., Cleveland Mus. Nat. Hist., 5:99, September 11, 1942; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:388, May 12, 1958; Hall and Kelson, The mammals of North America, p. 58, March 31, 1959.

C[ryptotis]. p[arva]. parva, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

TABLE 3.—CRANIAL MEASUREMENTS OF THREE SPECIES OF SORICIDS.

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Cranial breadth	Maxillary breadth	Interorbital breadth	Length of maxillary tooth-row
Sorex cinereus haydeni, 12 mi. NNW Springview, Keya Paha County					
77893 KU, ♀	15.5	7.6	4.4	2.9	5.3
77894 KU, ♀	15.7	7.7	4.4	2.8	5.7
77895 KU, ♀	15.8	7.6	4.4	2.9	5.7
77896 KU, ♂	15.8	7.6	4.4	2.8	5.7
1 mi. S Atkinson, Holt County					
79247 KU, ♀	15.5	7.7	4.2	2.8	5.6
79248 KU, ♀	15.8	7.6	4.2	2.8	5.8
79249 KU, ♂	15.7	7.7	4.2	2.7	5.8
Blarina brevicauda brevicauda, vicinity type locality					
Average 18 (11♂, 7♀)	24.0	13.5	8.7	6.3	9.3
Minimum	22.8	12.8	8.2	5.9	8.9
Maximum	24.9	14.0	9.1	6.5	9.7
Blarina brevicauda carolinensis, Richardson County					
Average 20 (7♂, 12♀, 1?)	21.1	11.5	7.6[19]	5.7	8.2[19]
Minimum	20.1	11.0	7.3	5.3	8.0
Maximum	21.9	12.2	7.9	5.9	8.6
5 mi. N, 2 mi. W Parks, Dundy County					
Average 20 (11♂, 9♀)	21.2	11.6	7.8	5.7	8.3
Minimum	20.7	11.3	7.5	5.5	7.8
Maximum	21.9	12.2	8.1	6.0	8.8
vicinity North Platte, Lincoln County					
Average 5 (2♂, 2♀, 1?)	21.1	11.9	7.9	5.7	8.2
Minimum	20.9	11.8	7.7	5.6	8.0
Maximum	21.3	12.0	8.1	5.9	8.5
Cryptotis parva parva, Blair, Washington County					
Average 5 (3♂, 2♀)	15.4	7.7	5.1	3.6	5.7
Minimum	14.9	7.6	4.9	3.5	5.4
Maximum	15.7	7.9	5.2	3.8	5.9

Distribution in Nebraska.—Throughout southern part of state, west in northern part of state certainly to Cherry County. See Fig. 8.

External measurements.—Average and extreme measurements of 11 specimens (eight males, three females) from Blair are: 79.1 (73-86); 16.4 (15-18); 10.5 (10-11). For cranial measurements see Table 3.

Hamilton (1944:2) recorded the weight of adults from New York and Virginia as varying from 4.4-5.7 grams. Two females from Omaha weighed 4.1 and 4.75 grams.

Records of occurrence.—Specimens examined, 45, as follows: Cherry County: W of Crookston, 1 (NSM). Douglas County: Omaha, 2; *South Omaha,* 1 (HM). Dundy County: 5 mi. N, 2 mi. W Parks, 1; 2 mi. SW Benkelman, 1; Haigler, 1 (USNM). Gage County: 1 mi. S, 1 mi. W Barnston, 1. Keith County: 4 mi. NNW Keystone, 1. Lancaster County: *1 mi. N Lincoln,* 2 (NSM); Lincoln, 11 (3 AMNH, 2 NSM, 3 UC, 3 UNDZ); *College View (Lincoln),* 3 (1 CNHM, 2 UNDZ); *between College View and Cheney,* 1 (UNDZ). Lincoln County: Conroy Canyon (SW corner sec. 4, T. 11 N, R. 27 W), 5 mi. S, 2½ mi. W Brady, 1 (NSM). Pawnee County: 4 mi. S, 8 mi. W Pawnee City, 1. Red Willow County: 8 mi. S, 3 mi. E McCook, 1. Sarpy County: Ft. Crook, 2 (AMNH). Washington County: Blair, 11 (USNM). Webster County: Bladen, 1 (HM).

Additional records: Antelope County: Neligh (Cary, MS). Lancaster County: 9 mi. NW Lincoln (Whelan, 1937:365). Lincoln County: near North Platte (Swenk, MS). Red Willow County: 9 mi. NE Bartley (Jones, 1949*b*:5). Washington County: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], the type locality. Wayne County: 4 mi. SE Carroll (Jones, 1949*b*:5).

Family Talpidae—Moles

Scalopus aquaticus

Eastern Mole

The eastern mole occurs throughout Nebraska. In the eastern part of the state the species is found in a variety of habitats and is entirely absent only from the driest places; ordinarily, however, it lives in moist, pliable soils. Marginal habitats seemingly are entered only in periods of relatively high rainfall. In the western part of Nebraska the distribution of *S. aquaticus* is limited primarily to moist soils along river systems, around lakes, in irrigated agricultural lands, and in lawns and gardens. There, too, excessive rainfall may lead to temporary dispersal of moles to places that are drier than those ordinarily inhabited. Along Soldier Creek in eastern Sioux County in July and August of 1957, when relatively high precipitation prevailed for the season, T. A. Vaughan and I found foraging tunnels on dry, somewhat sandy hillsides a half mile or more from the moist creek bottom.

The known northwestern limit of distribution of the eastern mole is reached just beyond the borders of Nebraska. The species is known from two localities in extreme southeastern South Dakota but is not recorded from elsewhere in that state. It is known from

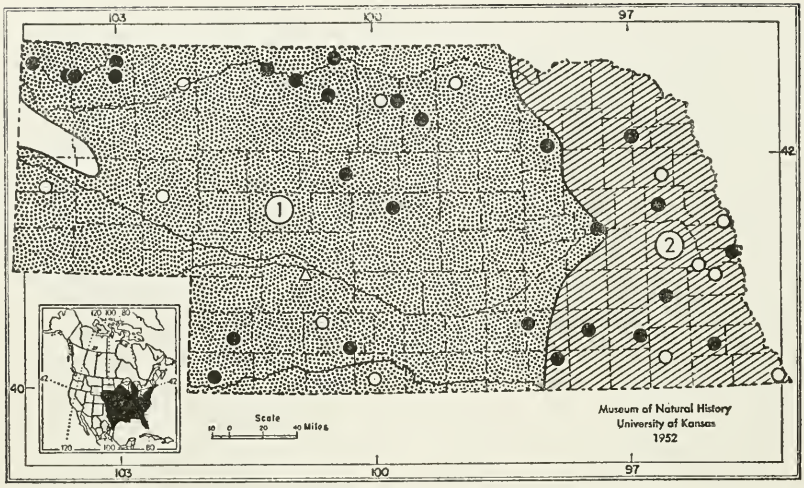

FIG. 9. Distribution of *Scalopus aquaticus* in Nebraska. 1. *S. a. caryi.* 2. *S. a. machrinoides.* For explanation of symbols see Fig. 5.

only one locality in Wyoming (in the extreme southeastern part) but occurs at several places in northeastern Colorado.

A female bears a single litter annually of 2-5 young in spring. A female from Neligh taken on May 3, 1958, contained 3 embryos that measured 27 mm. (crown-rump length). Males average larger than females.

Scalopus aquaticus caryi Jackson

Scalopus aquaticus caryi Jackson, Proc. Biol. Soc. Washington, 27:20, February 2, 1914 (type locality, Neligh, Antelope Co., Nebraska); Jackson, N. Amer. Fauna, 38:48, September 30, 1915; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:24, October, 1936; Poole and Schantz, Bull. U. S. Nat. Mus., 178:200, April 9, 1942; Hall and Kelson, The mammals of North America, p. 74, March 31, 1959.

Scallops [sic] Argentatus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880 (part).

Scalops argentatus, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:257, November, 1896.

Scalops aquaticus machrinus, True, Proc. U. S. Nat. Mus., 19:20 (specimen mentioned in footnote on p. 27), December 21, 1896 (part); Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Scalopus aquaticus machrinus, Swenk, Proc. Nebraska Acad. Sci., 8:135, September, 1908 (part); Swenk, Univ. Nebraska Studies, 89:79, September, 1908 (part).

Scalopus a[quaticus]. caryi, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Scalopus aquaticus machrinoides, Jackson, N. Amer. Fauna, 38:45, September 30, 1915 (part); Hall and Kelson, The mammals of North America, p. 74, March 31, 1959 (part).

S[calopus]. a[quaticus]. caryi, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Western two-thirds of state, east certainly to Antelope, Platte, and Clay counties. See Fig. 9.

External measurements.—Average and extreme measurements of seven males from the vicinity of Neligh followed by measurements of a female from there are: 167.6 (157-182), 171; 31.7 (31-32.5), 28; 21.7 (20.3-23), 21. Average and extreme measurements of six males and seven females from Sioux County are, respectively: 155.4 (145-166), 150.8 (136-166); 25.8 (19-31), 25.4 (22-28); 21.3 (20-22), 20.2 (19-22). For cranial measurements see Table 4. Weight in grams of five specimens from Sioux County (three males, two females) are, respectively: 80.2, 76.5, 68.4, 54.2, 54.0.

Remarks.—For comparison with *Scalopus aquaticus machrinoides,* geographically adjacent to the east in Nebraska, see account of that subspecies.

The type locality of *S. a. caryi* (Neligh, Antelope County) is near the eastern limit of the range of the subspecies. All specimens from there possess the pale coloration diagnostic of *caryi* throughout its range but some individuals approach *S. a. machrinoides* in cranial and especially external dimensions (see external measurements and Table 4). The small measurements of the holotype and two other males from Neligh listed by Jackson (1915:49) more nearly approach the average of *caryi* from more westerly localities than do measurements of any of the other specimens that I have seen from the vicinity of Neligh.

A specimen from 3 mi. S Columbus (NSM 3067) and one from Inland (HM 1861) are intermediate in coloration between *caryi* and *machrinoides.* The former specimen, a male, is larger in cranial dimensions than specimens from western Nebraska (but smaller than most topotypes) and typical in external measurements of *caryi,* to which it is here referred. The specimen from Inland is mounted, has the skull inside the skin, and lacks data as to sex and measurements. M. H. Swenk (MS) and I independently assessed the color as nearer that of *caryi* than *machrinoides* and it is on this basis that I have assigned it to the former.

The specimen from Perch (AMNH 11533/9816), assigned by Jackson (*loc. cit.*) to *machrinoides* (see also Hall and Kelson, 1959:74), is in my opinion unquestionably *caryi.* External and cranial measurements are typical of the latter. The color is darker than in *caryi* but seemingly this results from dust and dirt in the pelage, possibly acquired since the specimen was obtained.

Several specimens of *caryi* from Nebraska have been incorrectly reported previously as concerns locality. The specimen (USNM 116363) recorded from Kennedy by Jackson (*loc. cit.*) is actually from 18 mi. NW of that place. His record from the "Niobrara

River" (NSM 4069) is from 10 mi. S Cody, Cherry County. Hall and Kelson (1959:73) mapped the latter locality at the mouth of the Niobrara (in Knox County).

Records of occurrence.—Specimens examined, 47, as follows: ANTELOPE COUNTY: Neligh, 4 (1 NSM, 3 USNM); *1 mi. SW Neligh,* 4. BROWN COUNTY: Long Pine, 1 (Stanford Univ.). CHASE COUNTY: 2 mi. W Enders, 1. CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge, 2 (NSM); Niobrara River, 10 mi. S Cody, 1 (NSM); 18 mi. NW Kennedy, 1 (USNM); 20 mi. S Valentine, 1 (UMMZ); *Hackberry Lake, Valentine Nat'l Wildlife Refuge,* 1. CLAY COUNTY: Inland, 1 (HM). CUSTER COUNTY: Victoria Springs, 1 (UMMZ). DAWES COUNTY: Chadron, 1 (CSTC); 10 mi. S Chadron, 1 (UMMZ); Crawford, 2 (NSM); *3 mi. W Crawford,* 2 (1 NSM). DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 4. FRONTIER COUNTY: 15 mi. SE Stockville, 1 (NSM). PLATTE COUNTY: 3 mi. S Columbus, 1 (NSM). ROCK COUNTY: Perch, 1 (AMNH). SIOUX COUNTY: *Warbonnet Canyon,* 3 (NSM); *Monroe Canyon,* 3 (NSM); 8 mi. N Harrison, 2 (UMMZ); *5½ mi. N, 2½ mi. W Harrison,* 1 (NGFPC); 7 mi. W Crawford, 5 (NSM). THOMAS COUNTY: 4 mi. W Halsey, 1; *1 mi. W Halsey,* 1.

Additional records: BROWN COUNTY: Ainsworth (specimen catalogued in CNHM, but not now to be found). FRONTIER COUNTY: Curtis (Swenk, MS). FURNAS COUNTY: Hendley (Gates, 1945:11). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272). HOLT COUNTY: 10 mi. NE Stuart (Jones, field notes). LINCOLN COUNTY: no specific locality (Fichter, 1941:28). SCOTTS BLUFF COUNTY: 7 mi. S Gering (Jones, field notes). SHERIDAN COUNTY: 11 mi. S Gordon (Jones, field notes). County unknown: *"Sand Hills"* (Jackson, 1915:49).

Scalopus aquaticus machrinoides Jackson

Scalopus aquaticus machrinoides Jackson, Proc. Biol. Soc. Washington, 27:19, February 2, 1914 (type locality, Manhattan, Riley Co., Kansas); Jackson, N. Amer. Fauna, 38:45, September 30, 1915 (part); Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949; Hall and Kelson, The mammals of North America, p. 74, March 31, 1959 (part); Velich, Jour. Mamm., 42:92, February 20, 1961.

Scalops aquaticus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Scallops [sic] Argentatus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880 (part).

Scalops aquaticus machrinus, True, Proc. U. S. Nat. Mus., 19:20 (specimens mentioned on p. 29), December 21, 1896 (part).

Scalopus aquaticus machrinus, Swenk, Proc. Nebraska Acad. Sci., 8:135, September, 1908 (part); Swenk, Univ. Nebraska Studies, 89:79, September, 1908 (part).

S[calopus]. a[quaticus]. machrinoides, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Eastern third of state, west certainly to Wayne and Fillmore counties. See Fig. 9.

External measurements.—Average and extreme measurements of eight males and four females from Lincoln are, respectively: 177.7 (174-185), 171.3 (163-187); 33.6 (28.5-38), 33.5 (32-34); 22.5 (21-24), 21.5 (19-25). For cranial measurements see Table 4.

A female from Lincoln weighed 99.2 grams.

Remarks.—From *Scalopus aquaticus caryi*, geographically adjacent to the west in Nebraska, *S. a. machrinoides* differs in being conspicuously larger externally and cranially (see measurements) and in having darker (brownish rather than silvery gray) pelage both dorsally and ventrally.

All the specimens here referred to *machrinoides* can be clearly so assigned by virtue of large external and cranial size and relatively dark coloration with the exception of the specimen from Angus (AMNH 121617), which is an intergrade with *caryi*. Jackson (1915:46) remarked that "specimens from Lincoln, Nebr., [are] smaller and paler than typical *machrinoides*." Specimens from

TABLE 4.—CRANIAL MEASUREMENTS OF TWO SUBSPECIES OF SCALOPUS AQUATICUS.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Condylobasal length	Mastoid breadth	Postorbital constriction	Palatal length	Alveolar length P4–M3	Depth of skull
Scalopus aquaticus caryi, vicinity type locality							
77938 KU, ♂	36.2	35.7	18.7	8.1	17.5	9.3	10.4
77939 KU, ♂	36.0	35.3	18.7	8.0	17.2	9.4	10.4
77941 KU, ♂	36.6	36.1	18.6	8.1	17.4	9.5	10.6
116798 USNM, ♂ (type)	34.7	33.6	17.8	8.1	16.3	8.9	10.4
77940 KU, ♀	34.8	34.1	17.8	7.8	16.9	8.9	10.1
Sioux County							
Average 5 (♂)	34.9	34.1	17.7	7.7	16.5	8.7	10.3
Minimum	34.5	33.7	17.1	7.6	16.2	8.5	10.1
Maximum	35.6	34.9	18.2	7.8	16.9	9.1	10.4
12004 NSM, ♀	32.2	31.2	16.4	7.5	15.2	8.6	9.9
12005 NSM, ♀	32.9	32.1	16.9	7.5	15.6	8.2	10.1
5 mi. N, 2 mi. W Parks, Dundy County							
50129 KU, ♂	34.6	33.9	17.7	7.6	16.6	8.5	10.4
72491 KU, ♂	34.4	33.8	18.0	7.7	16.5	9.1	10.2
72492 KU, ♂	34.5	33.7	17.9	7.8	16.6	8.4	10.4
72217 KU, ♀	31.8	30.9	16.4	7.2	15.2	8.3	9.6
Scalopus aquaticus machrinoides, Lincoln, Lancaster County							
Average 8 (♂)	38.0	37.4	19.3	8.2	18.1	9.3	10.8
Minimum	36.7	35.9	18.2	7.8	17.4	8.9	10.4
Maximum	40.2	39.8	20.2	8.6	19.3	9.6	11.2
Average 4 (♀)	37.0	36.1	19.3	8.3	17.4	8.9	10.6
Minimum	36.1	35.4	18.6	8.1	17.1	8.6	10.5
Maximum	38.4	37.7	20.1	8.4	18.4	9.1	10.9

Lincoln available to me (which include those studied by Jackson) are somewhat paler than specimens from northeastern Kansas, but I note no especial difference in size.

Records of occurrence—Specimens examined, 31 as follows: DODGE COUNTY: Everett, 1 (USNM). FILLMORE COUNTY: Geneva, 1 (HM). JOHNSON COUNTY: Tecumseh, 1 (NSM). LANCASTER COUNTY: Lincoln, 22 (2 MVZ, 2 NGFPC, 13 NSM, 2 UC, 3 UNDZ); *3 mi. S Lincoln*, 1 (UC). NUCKOLLS COUNTY: Angus, 1 (AMNH). SALINE COUNTY: 3 mi. W Wilber, 1 (NSM). SARPY COUNTY: Ft. Crook, 2 (AMNH). WAYNE COUNTY: Wayne, 1 (Wayne State Teachers College).

Additional records: CASS COUNTY: Louisville (Gates, 1945:11). CUMING COUNTY: West Point (Swenk, 1908:135). GAGE COUNTY: Beatrice (Swenk, 1908:135). RICHARDSON COUNTY: vicinity Rulo (Jones and Webb, 1949:317). SARPY COUNTY: *Child's Point* (specimen catalogued in NSM, but not now to be found); Linoma Beach (Velich, 1961:92). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369).

Order CHIROPTERA—Bats

Fourteen kinds (of 12 species, of seven genera) of bats are known from Nebraska; several additional species may occur within the state. Nebraskan bats represent two families, Vespertilionidae and Molossidae, both in the suborder Microchiroptera.

Most species are known from only a few localities in the state, and in some instances by only a few specimens. Caves and crevices in cliffs and rock ledges are favored retreats for many kinds of bats. Nebraska has no natural caves worthy of the name and has but few areas of cliffs and rock ledges (and these are all but limited to the western part of the Panhandle). Scarcity of these features, coupled with the vast areas of relatively treeless prairie, restrict in one way or another all species of bats occurring in the state. In large areas of the Sand Hills for example, no bats are resident, although some species probably migrate across these areas and thereby may be found there occasionally in spring and in late summer or early autumn.

KEY TO NEBRASKAN BATS

1.	Tail extending conspicuously beyond uropatagium; anterior border of ear having six to eight horny excrescences; lower incisors bifed (family Molossidae) ..... *Tadarida brasiliensis*, p.	99
1′.	Tail extending slightly or not at all beyond uropatagium; anterior border of ear lacking horny excrescences; lower incisors trifed (family Vespertilionidae) 2	
2(1′).	Single incisor in each upper tooth-row 3	
2′.	Two incisors in each upper tooth-row 5	
3(2).	Upper surface of uropatagium nude or only thinly furred at base; 30 teeth (only one upper premolar on each side). *Nycticeius humeralis*, p.	97

3′. Upper surface of uropatagium thickly furred; 32 teeth (two upper premolars on each side)....4

4(3′). Upper parts hoary (dark brownish tipped with grayish white); forearm more than 45; condylobasal length more than 15.5. *Lasiurus cinereus*, p. 95

4′. Upper parts reddish orange to yellowish brown; forearm less than 45; condylobasal length less than 14.5....*Lasiurus borealis*, p. 93

5(2′). Upper surface of uropatagium furred proximally for a third to a half of its length; 34 or 36 teeth....6

5′. Upper surface of uropatagium nude or with few hairs at base; 32 or 38 teeth....7

6(5). Forearm more than 36; color blackish, frosted with white; 36 teeth (three lower premolars on each side)...*Lasionycteris noctivagans*, p. 87

6′. Forearm less than 36; color reddish brown or yellowish brown; 34 teeth (two lower premolars on each side)..*Pipistrellus subflavus*, p. 89

7(5′). Total length more than 105; condylobasal length more than 17.0; 32 teeth....*Eptesicus fuscus*, p. 90

7′. Total length less than 105; condylobasal length less than 15.0; 38 teeth....8

8(7′). Ear 16 or more from notch; length of maxillary tooth-row more than 5.5; length of mandibular tooth-row more than 6.9....9

8′. Ear usually less than 15 from notch; length of maxillary tooth-row 5.5 or less; length of mandibular tooth-row 6.9 or less....10

9(8). Upper parts usually pale brownish, frequently contrasting with blackish color of ears and membranes; ear more than 18 from notch; skull larger, greatest length more than 15.5..*Myotis evotis*, p. 79

9′. Upper parts darker, averaging near olive brown, not especially contrasting with color of ears and membranes; ear from notch 16–18; skull smaller, greatest length less than 15.7....*Myotis keenii*, p. 80

10(8′). Upper parts pale yellowish brown, contrasting noticeably with blackish ears and membranes; forearm less than 34; interorbital constriction less than 3.6....*Myotis subulatus*, p. 84

10′. Upper parts brownish, not contrasting noticeably with ears and membranes; forearm more than 34; interorbital constriction more than 3.8....11

11(10′). Calcar keeled; wing furred on underside to level of elbow; braincase rising abruptly from rostrum....*Myotis volans*, p. 85

11′. Calcar not keeled; wing not furred on underside to level of elbow; braincase rising gradually from rostrum....*Myotis lucifugus*, p. 81

Family VESPERTILIONIDAE—Vespertilionid Bats

Myotis evotis

Long-eared Myotis

On July 22, 1901, on the Pine Ridge in Sioux County, Merrit Cary caught a specimen of the long-eared myotis in an insect net at dusk over a pond. In 1948, 1949, 1952, and 1957, I collected bats in the Pine Ridge of Sioux County and obtained no specimens of this species; probably it occurs only rarely in extreme northwestern Nebraska.

Females give birth to a single young in late May or June (Cockrum, 1956:493).

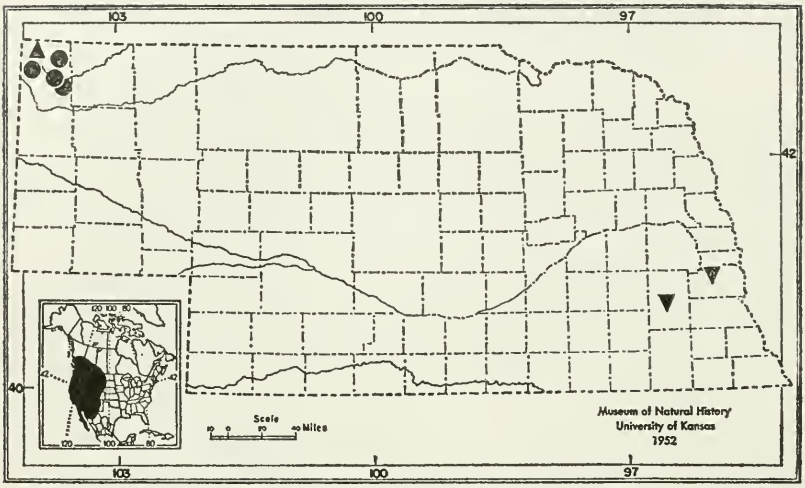

FIG. 10. Records of occurrence of three species of *Myotis* in Nebraska. *Myotis evotis evotis* (triangle). *Myotis keenii septentrionalis* (inverted triangles). *Myotis volans interior* (circles). Inset map shows distribution of *M. evotis* in North America.

Myotis evotis evotis (H. Allen)

Vespertilio evotis H. Allen, Smiths. Misc. Coll., 7(165):48, June, 1864 (type locality restricted to Monterey, Monterey Co., California, by Dalquest, Proc. Biol. Soc. Washington, 56:2, February 25, 1943).

Myotis evotis, Miller, N. Amer. Fauna, 13:77, October 16, 1897; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:137, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:81, September, 1908; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920.

Myotis evotis evotis, Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:273, May 31, 1952.

M[yotis]. e[votis]. evotis, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Known only from Sioux County; possibly in other parts of Pine Ridge. See Fig. 10.

External measurements.—Available measurements of the single Nebraskan specimen, a male, followed by those of a female from 15 mi. S, 21 mi. W Cody, 6200 ft., Park County, Wyoming (KU 37311), are: 93, 91; 41, 43; —, 11; —, 23; 38.9, 39.1. The Wyoming specimen weighed 5.3 grams. For cranial measurements see Table 5.

Record of occurrence.—Specimen examined, 1, as follows: SIOUX COUNTY: Warbonnet Canyon, 1 (NSM).

Myotis keenii

Keen's Myotis

Keen's myotis is known in Nebraska from three man-made caves in the eastern part of the state—the Kiewit Stone Quarry near

Meadow, the National Stone Quarry near Louisville, and commercially operated Robbers' Cave on the southern outskirts of Lincoln. The species breeds and is a common resident the year around in the two caves mentioned first; it has been taken only in autumn at Robbers' Cave but probably resides there throughout the year.

Even though the species is known only from the eastern part of the state it may occur in the northern and northwestern parts as well. Jones and Packard (1958:150) recorded *M. k. septentrionalis* from Elk Mountain, Custer County, in southwestern South Dakota, and that subspecies is known also from ½ mi. E Buckhorn, 6100 ft., Weston County, Wyoming (KU 41590). Females bear a single young in early summer (Hamilton, 1943:78).

Myotis keenii septentrionalis (Trouessart)

[Vespertilio gryphus] var. *septentrionalis* Trouessart, Catalogus mammalium . . ., fasc. 1, p. 131, 1897 (type locality, Halifax, Nova Scotia).

Myotis keenii septentrionalis, Miller and G. M. Allen, Bull. U. S. Nat. Mus., 144:105, May 25, 1928; Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:273, May 31, 1952; Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 7:279, August 25, 1952; Hall and Kelson, The mammals of North America, p. 168, March 31, 1959.

M[yotis]. k[eenii]. septentrionalis, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Known only from eastern part of state; possibly also in northern and northwestern parts. See Fig. 10.

External measurements.—Average and extreme measurements of 10 specimens (five males, five females) from ½-1 mi. W Meadow are: 93.5 (86-99); 39.5 (36-43); 9.3 (8-10); 16.9 (16-18); 35.3 (33.3-36.5). One December-taken male weighed 6.3 grams. For cranial measurements see Table 5.

Records of occcurrence.—Specimens examined, 58, as follows: CASS COUNTY: *1-1½ mi. NE Louisville,* 5 (1 NSM). LANCASTER COUNTY: Lincoln, 11 (UC). SARPY COUNTY: ½-1 mi. W Meadow, 42 (3 MSU, 2 MVZ, 1 NGFPC, 7 NSM, 1 UNM, 2 W. G. Frum Collection).

Myotis lucifugus

Little Brown Myotis

Myotis lucifugus is known certainly in Nebraska only from Sarpy County and from the Pine Ridge and adjacent areas in Dawes and Sioux counties. The only report of the species from the interior of the state is that of Smith (1958:59), who listed it from Thomas County. Inasmuch as Smith preserved no specimens and his identification cannot now be verified, his record is not admitted here. Probably the ranges of the two subspecies (*M. l. lucifugus*

and *M. l. carissima*) known from Nebraska do not meet in the state, although it is possible that the two meet along the Niobrara River.

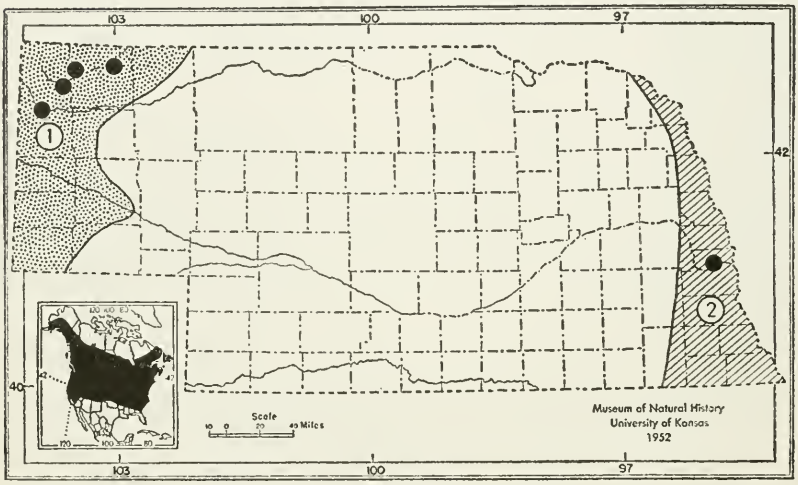

FIG. 11. Distribution of *Myotis lucifugus* in Nebraska. 1. *M. l. carissima.* 2. *M. l. lucifugus.* For explanation of symbols see Fig. 5.

M. l. carissima is one of the commonest bats on the Pine Ridge where I have found roosts and breeding colonies in buildings. *M. l. lucifugus* is known presently only from a series of man-made limestone quarries along the Platte River in Sarpy County where it is resident the year around (but only males have been taken) in association with *Myotis keenii septentrionalis, Pipistrellus subflavus subflavus,* and *Eptesicus fuscus fuscus.*

Females of this species give birth to a single offspring in the late spring or early summer (May to July).

Myotis lucifugus carissima Thomas

Myotis (*Leuconoe*) *carissima* Thomas, Ann. Mag. Nat. Hist., ser. 7, 13:383, May, 1904 (type locality, Yellowstone Lake, Yellowstone National Park, Wyoming).

Myotis lucifugus carissima, Cary, N. Amer. Fauna, 42:43, October 3, 1917; Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:273, May 31, 1952; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:89, March 3, 1955; Hall and Kelson, The mammals of North America, p. 160, March 31, 1959.

Myotis subulatus subulatus, Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:274, May 31, 1952 (part—see text).

M[yotis]. l[ucifugus]. carissima, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Known certainly only from Dawes and Sioux counties; probably in other parts of extreme western part of state. See Fig. 11.

External measurements.—Average and extreme measurements of 10 summer-taken specimens (one male, nine females) from 3 mi. W Crawford are: 96.4 (94-99); 39.1 (37-42); 10.6 (10-12); 14.3 (13-15); 37.4 (35.8-40.2). Weight in grams of these same specimens averaged 8.0 (6.4-9.2). For cranial measurements see Table 5.

Remarks.—From *Myotis lucifugus lucifugus* of eastern Nebraska, *M. l. carissima* differs in being noticeably paler, both dorsally and ventrally, and in averaging slightly larger in external and cranial dimensions (see external measurements and Table 5).

This subspecies was first reported from Nebraska by Webb and Jones (1952:273). Subsequently, it has been found to be one of the commonest bats in the northwestern part of the state.

Webb and Jones (*op. cit.*:274) reported a young, mummified bat with broken skull (KU 3458) from Agate as *Myotis subulatus subulatus*. After careful study of this specimen I now think it to be *M. l. carissima* because of its brownish rather than blackish ears and membranes, glossy-tipped dorsal pelage that more nearly agrees with that of *M. l. carissima* than that of *M. s. subulatus*, and relatively long hind foot (8.7 mm., dry).

Records of occurrence.—Specimens examined, 31, as follows: DAWES COUNTY: Chadron, 1 (NSM); *6 mi. S Chadron*, 1 (NSM); 3 mi. W Crawford, 18 (NSM). SIOUX COUNTY: *5½ mi. W Crawford*, 7 (NSM); 3 mi. S Glen, 2 (NSM); Agate, 2 (1 UMMZ).

Myotis lucifugus lucifugus (Le Conte)

V[espertilio]. lucifugus Le Conte, *in* McMurtrie, The animal kingdom . . . by the Baron Cuvier . . ., 1:431, 1831 (type locality, Georgia, probably the Le Conte Plantation near Riceboro, Liberty Co.).

Myotis lucifugus, Miller, N. Amer. Fauna, 13:59, October 16, 1897.

Myotis lucifugus lucifugus, Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:274, May 31, 1952.

M[yotis]. l[ucifugus]. lucifugus, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Known only from Sarpy County; probably occurring at some other places in extreme eastern part of state. See Fig. 11.

External measurements.—Average and extreme measurements of seven males from ½-1 mi. W Meadow are: 91.1 (85-100); 36.9 (33-40); 9.9 (8-11); 14.7 (14-16); 36.5 (35.0-38.4). One December-taken male weighed 6.5 grams. For cranial measurements see Table 5.

Remarks.—For comparison with *Myotis lucifugus carissima* of western Nebraska, see account of that subspecies.

M. l. lucifugus is known from but a single locality in the state but the species is known to roost in attics, barns, and the like and probably will be found elsewhere in eastern Nebraska. I have seen bats that I took to be *Myotis*, possibly *lucifugus*, in flight at dusk at several places along the Missouri River.

One specimen (KU 35076) lacks both of the second upper premolars (P3), although the mandibular dentition is normal. The maxillary tooth-row of this bat is thus shortened and measures only 4.7 as compared with 5.0-5.4 in other Nebraskan specimens.

M. l. lucifugus occurs along with *Myotis keenii septentrionalis* in the limestone quarries west of Meadow, from which species *lucifugus* differs in darker color, shorter ears, shorter tooth-rows, shorter rostrum, broader interorbital region and more abruptly elevated braincase.

Records of occurrence.—Specimens examined, 7, as follows: SARPY COUNTY: ½-1 mi. W Meadow, 7.

Myotis subulatus

Small-footed Myotis

This species presently is known only from the extreme northern and western parts of the state but probably occurs over most of the western half of Nebraska. Cockrum (1952:63) recorded it from three localities in western Kansas and it is widely distributed in both Colorado and Wyoming. I shot bats of this species in clearings in deciduous and coniferous timber and over several ponds in northwestern Nebraska. Some individuals have been taken from daytime retreats in barns where *Eptesicus fuscus pallidus* also was found. Swenk (1908:137) found two individuals under a loose strip of pine bark; Quay (1948:181) found some individuals in "pockets" behind loose sheets of rock in the badlands of northern

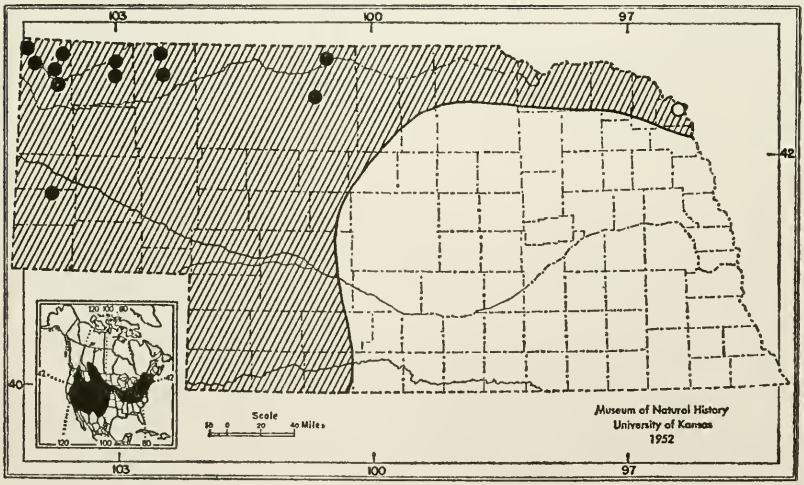

FIG. 12. Distribution of *Myotis subulatus subulatus* in Nebraska. For explanation of symbols see Fig. 5.

Sioux County; Stephens (1945:92) found one "between boards leaning against the wall" of a cottage. All specimens that I know of from Nebraska have been taken in the warm months, between May 2 and September 5.

A female taken in Sugarloaf Township, Sioux County, on July 12, 1944, contained a single embryo (Quay, *loc. cit.*), the usual number for the species.

Myotis subulatus subulatus (Say)

V[espertilio]. subulatus Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 2:65, 1823 (type locality, Arkansas River, near present town of La Junta, Otero Co., Colorado).

M[yotis]. subulatus, Lantz, Bull. Exp. Sta., Kansas State Agric. Coll., 129:397, April, 1905 (not Miller, N. Amer. Fauna, 13:75, October 16, 1897, who used the name *Myotis subulatus* but applied it exclusively to bats of the species *Myotis keenii*).

Myotis californicus ciliolabrum, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:138, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:82, September, 1908; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920.

Myotis subulatus subulatus, Miller and G. M. Allen, Bull. U. S. Nat. Mus., 144:168, May 25, 1928; Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:274, May 31, 1952; Hall and Kelson, The mammals of North America, p. 175, March 31, 1959.

Myotis subulatus, Stephens, Jour. Mamm., 26:92, February 23, 1945; Cockrum, Trans. Kansas Acad. Sci., 58:494, January 23, 1956.

Myotis s[ubulatus]. subulatus, Quay, Jour. Mamm., 29:181, May 14, 1948.

M[yotis]. s[ubulatus]. subulatus, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Northern and western parts of state. See Fig. 12.

External measurements.—Measurements of three females from the vicinity of Rushville are: 89, 88, 88; 34, 44, 38; 9, 9, 8; 15, 15, 15; 31.8, 31.6, 31.7. Corresponding measurements of a male and two females from Sioux County are, respectively: 86, 89, 82; 38, 38, 36; 8.5, 8, 7; 14, 14, 13; 32.9, 32.5, 30.8. A female from Sioux County weighed 5.1 grams and one from Dawes County weighed 6.9 grams. For cranial measurements see Table 5.

Records of occurrence.—Specimens examined, 18, as follows: BANNER COUNTY: 9 mi. N, 5 mi. E Harrisburg, 1. CHERRY COUNTY: Valentine, 1 (UNDZ); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 1. DAWES COUNTY: Chadron, 2 (1 CSTC, 1 USNM); *6 mi. S Chadron,* 2 (NSM); 10 mi. S Chadron, 1. SHERIDAN COUNTY: 15 mi. N Rushville, 2; Rushville, 1. SIOUX COUNTY: center of W ½ Antelope Twp., 1 (UMMZ); SE ¼ Sugarloaf Twp., 1 (UMMZ); Warbonnet Canyon, 1 (NSM); *Monroe Canyon, 5½ mi. N, 2½ mi. W Harrison,* 2 (NGFPC); 1 mi. N, 10 mi. W Crawford, 1 (NSM); Glen, 1 (NSM).

Additional record: DAKOTA COUNTY: Crystal Lake (Stephens, 1945:92).

Myotis volans

Long-legged Myotis

Myotis volans is known in Nebraska only from Sioux County, where, on June 22, 1944, W. B. Quay found "about 180" individuals

in a fissure that was parallel to the overhanging bank of a streamlet in the badlands north of Harrison. Quay (1948:181) noted that, ". . . of the several dozen of these bats examined closely, all were females. Four that were dissected contained a single fetus each." In the summer of 1957 Terry A. Vaughan and I shot single individuals at dusk or later by artificial light in Sioux County in the following situations: a male over a pond surrounded by some elms and boxelders and by ponderosa pine where *Eptesicus fuscus pallidus* and *Myotis lucifugus carissima* also were obtained; a female

TABLE 5.—CRANIAL MEASUREMENTS OF FIVE SPECIES OF MYOTIS.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Condylobasal length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of maxillary tooth-row	Length of mandibular tooth-row
Myotis evotis evotis, 15 mi. S, 21 mi. W Cody, Wyoming							
37311 KU, ♂	15.6	14.7	9.3	3.6	7.9	6.1	7.6
Myotis keenii septentrionalis, ½–1 mi. W Meadow, Sarpy County							
Average 10 (5♂, 5♀)	15.3	14.1	9.2	3.7	8.0	5.9	7.4
Minimum	14.7	13.6	8.6	3.4	7.6	5.6	7.0
Maximum	15.6	14.5	9.6	3.8	8.4	6.1	7.6
Myotis lucifugus carissima, 3 mi. W Crawford, Dawes County							
Average 10 (1♂, 9♀)	14.7	13.8	9.1	4.1	7.8	5.3	6.8
Minimum	14.3	13.2	8.9	3.9	7.5	5.2	6.6
Maximum	15.1	14.1	9.4	4.4	8.0	5.4	6.9
Myotis lucifugus lucifugus, ½–1 mi. W Meadow, Sarpy County							
Average 6 (♂)	14.5	13.6	9.0	4.1	7.8	5.2	6.5
Minimum	14.3	13.3	8.9	4.0	7.6	5.0	6.4
Maximum	14.7	13.8	9.2	4.1	7.9	5.4	6.7
Myotis subulatus subulatus, vicinity Rushville, Sheridan County							
60527 KU, ♀	14.1	13.1	8.4	3.3	7.2	5.2	6.5
76857 KU, ♀	14.0	13.1	8.2	3.2	6.8	5.2	6.6
76858 KU, ♀	14.3	....	....	3.3	....	5.3	6.4
Sioux County							
12009 NSM, ♀	13.9	13.0	8.4	3.2	7.0	5.2	6.4
105937 UMMZ, ♂	14.4	13.3	8.7	3.4	7.2	5.2	6.5
105938 UMMZ, ♀	14.2	13.0	8.6	3.2	7.4	5.2	6.5
Myotis volans interior, Sioux County							
12012 NSM, ♀	14.5	14.1	8.8	3.9	7.7	5.5	6.9
12013 NSM, ♂	14.2	13.8	8.8	4.0	7.9	5.3	6.8
12014 NSM, ♀	14.2	13.6	8.8	4.0	7.7	5.2	6.7

at a clearing in deciduous timber along a small creek, with pines on nearby higher slopes, where *Myotis subulatus subulatus* and *Lasiurus cinereus cinereus* also were taken; and a female over a stock pond in the barren badlands near Orella along with one *Lasiurus cinereus cinereus.*

The easternmost occurrences of *Myotis volans* in the United States are in northwestern Nebraska and southwestern South Dakota.

Myotis volans interior Miller

Myotis longicrus interior Miller, Proc. Biol. Soc. Washington, 27:211, October 31, 1914 (type locality, 5 mi. S Twining, 11,300 ft., Taos Co., New Mexico).

Myotis volans interior, Miller and G. M. Allen, Bull. U. S. Nat. Mus., 144: 142, May 25, 1928; Quay, Jour. Mamm., 29:181, May 14, 1948; Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:275, May 31, 1952; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:95, March 3, 1955; Hall and Kelson, The mammals of North America, p. 172, March 31, 1959.

M[yotis]. v[olans]. interior, Jones, Trans. Kansas Acad. Sci., 60:274, October 22, 1957.

Distribution in Nebraska.—Known certainly only from Sioux County; possibly in other parts of extreme western Nebraska. See Fig. 10.

External measurements.—Average and extreme measurements of five specimens (one male, four females) from Sioux County are: 96.9 (92-100); 43.8 (42-46); 9.6 (9-10); 12.5 (11-14); 38.4 (36.0-40.0). A male and two females weighed 7.4, 7.3, and 8.3 grams, respectively. For cranial measurements see Table 5.

Records of occurrence.—Specimens examined, 5, as follows: Sioux County: 1 mi. S, 4 mi. W Orella, 1 (NSM); 8 mi. N Harrison, 2 (UMMZ); 1 mi. N, 10 mi. W Crawford, 1 (NSM); 3 mi. S Glen, 1 (NSM).

Lasionycteris noctivagans

Silver-haired Bat

The silver-haired bat may be present in Nebraska only during migrations—northward migration in late spring and southward migration in late summer and early autumn. Possibly a few individuals reside all summer in northern Nebraska along the Niobrara River and in the Pine Ridge country. A female that was obtained in mid-June, 1956, along the Snake River (a tributary of the Niobrara) in Cherry County could have been either a late migrant or a resident. Swenk (1908:138) regarded the species in Nebraska as "fairly common during migrations, probably not breeding within our limits."

A male with unworn teeth and thus probably a young of the year that was taken on August 28, 1910, at Lincoln was supposedly migrating southward. It was "caught in brick pile" according to

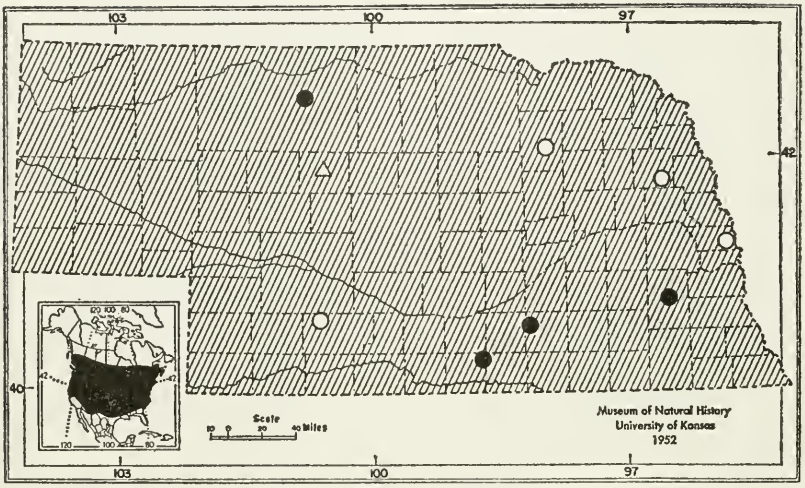

FIG. 13. Distribution of *Lasionycteris noctivigans* in Nebraska. For explanation of symbols see Fig. 5.

the specimen label. Specimens from Inland and Campbell were obtained even later in the year, the former on September 8, 1918, and the latter on October 2, 1945.

Lasionycteris noctivagans breeds in the northern part of its range where one or usually two young are born from late May to early July.

Lasionycteris noctivagans (Le Conte)

V[espertilio]. noctivagans Le Conte, *in* McMurtrie, The animal kingdom . . . by the Baron Cuvier . . ., 1:431, 1831 (type locality, eastern United States).

[Lasionycteris] noctivagans, Peters, Monatsb. k. preuss. Acad. Wiss., Berlin, p. 648 (for 1865), 1866.

Lasionycteris noctivagans, H. Allen, Bull. U. S. Nat. Mus., 43:105, March 14, 1894; Miller, N. Amer. Fauna, 13:86, October 16, 1897; Swenk, Proc. Nebraska Acad. Sci., 8:138, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:82, September, 1908; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:275, May 31, 1952; Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Scotophilus noctivagans, H. Allen, Smiths. Misc. Coll., 7(165):39, June, 1864.

Distribution in Nebraska.—Entire state during migrations; possibly resident in northern Nebraska in summer. See Fig. 13.

External measurements.—Measurements of a male from Lincoln, followed by a female from the Snake River, Cherry County, are: 98, 94; 39, 35; —, 9; 11 (crown), 15; 40.2, 39.2. For cranial measurements see Table 6.

Records of occurrence.—Specimens examined, 5, as follows: CHERRY COUNTY: Snake River, NW of Valentine Nat'l Wildlife Refuge, 1 (NGFPC). CLAY COUNTY: Inland, 1 (HM). FRANKLIN COUNTY: Campbell, 1 (HM). LANCASTER COUNTY: Lincoln, 1 (AMNH). County unknown: *"Nebraska,"* 1 (USNM).

Additional records: ANTELOPE COUNTY: Neligh (Cary, MS). CLAY COUNTY: *Harvard* (Swenk, MS). CUMING COUNTY: West Point (Swenk, 1908:138). DOUGLAS COUNTY: Omaha (Swenk, 1908:138). FRONTIER COUNTY: Curtis (Swenk, MS). THOMAS COUNTY: no specific locality (Smith, 1958:59). County unknown: *"Platte River"* (Miller, 1897:87).

Pipistrellus subflavus

Eastern Pipistrelle

The eastern pipistrelle is the smallest Nebraskan bat. It is known in the state only from limestone quarries on both sides of the Platte River in Cass and Sarpy counties where it has been taken along with *Myotis lucifugus lucifugus, Myotis keenii septentrionalis,* and *Eptesicus fuscus fuscus.* In winter this species, individuals of which are usually solitary in hibernation, is the commonest in the quarries of the four bats that occur there. In summer it is the rarest of the four species. Probably the Platte River quarries serve as a place of hibernation for many individuals that take up residence elsewhere during the summer. Eastern pipistrelles are known to roost in attics, old buildings, and the like and probably will be found at other places in eastern Nebraska. The species is known from several localities in northeastern Kansas.

Females have one to three young (usually two or three), probably in about mid-June at the latitude of Nebraska.

Pipistrellus subflavus subflavus (F. Cuvier)

V[espertilio]. subflavus F. Cuvier, Nouv. Ann. Mus. Hist. Nat. Paris, 1:17, 1832 (type locality restricted to 3 mi. SW Riceboro, Liberty Co., Georgia, by W. H. Davis, Jour. Mamm., 40:522, November 20, 1959).

Pipistrellus subflavus, Miller, N. Amer. Fauna, 13:90, October 16, 1897.

Pipistrellus subflavus subflavus, Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:276, May 31, 1952; Polder, Proc. Iowa Acad. Sci., 60:719, 1953; Hall and Kelson, The mammals of North America, p. 183, March 31, 1959; Davis, Jour. Mamm., 40:522, November 20, 1959.

P[ipistrellus]. s[ubflavus]. subflavus, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Known certainly only from Cass and Sarpy counties; possibly occurs elsewhere in extreme eastern part of state. See Fig. 17.

External measurements.—Average and extreme measurements of 10 winter-taken specimens (six males, four females) from ½ mi. W Meadow are: 83.0 (75-90); 37.5 (33-41); 9.1 (8-10); 13.0 (12-14); 33.2 (31.6-34.5). Two

males and two females from this series weighed in grams 3.8, 4.5, 5.4, and 6.0, respectively (average, 4.9). For cranial measurements see Table 6.

Records of occurrence.—Specimens examined, 36, as follows: CASS COUNTY: *1-1½ mi. NE Louisville,* 8 (3 CNHM, 4 NSM). SARPY COUNTY: ½-1 mi. W Meadow, 28 (4 NSM, 2 MVZ, 1 NGFPC, 3 P. H. Krutzsch Collection, 2 W. G. Frum Collection).

Eptesicus fuscus

Big Brown Bat

The big brown bat is one of the two largest species of Nebraskan bats and, possibly excepting the red bat, *Lasiurus borealis,* the commonest. The species is widely distributed in the state. It is a common summer resident on the Pine Ridge of northwestern Nebraska and along the Niobrara River farther east. Probably it winters in northern Nebraska inasmuch as two were obtained on October 23, 1955, in a shelter house at Ponca State Park. The species is a common inhabitant the year around of the limestone

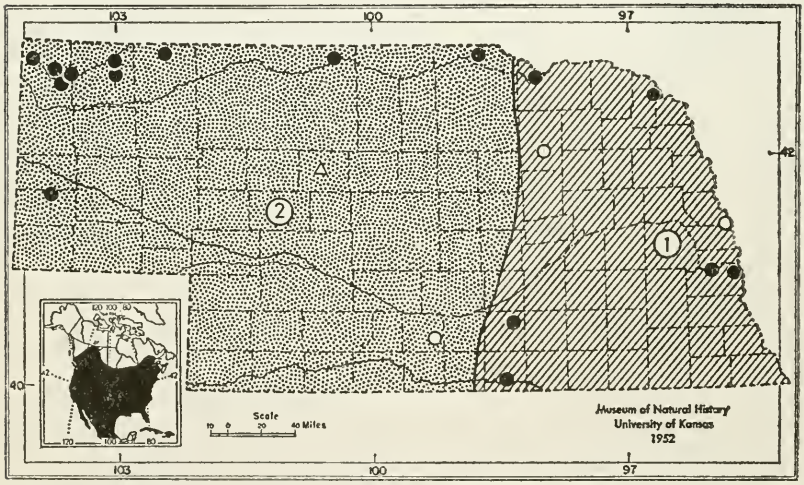

FIG. 14. Distribution of *Eptesicus fuscus* in Nebraska. 1. *E. f. fuscus.* 2. *E. f. pallidus.* For explanation of symbols see Fig. 5.

quarries in Cass and Sarpy counties, and has been taken both in summer and winter at Hastings. Few specimens are available from the central part of Nebraska but several persons from different places there have described to me large, brown bats that roosted in barns, which I am certain were *Eptesicus.*

In northwestern Nebraska I have found the species roosting in buildings and in rock fissures. T. A. Vaughan and I obtained many

specimens of *E. f. pallidus* in July and August of 1957 in Sioux County where all adults taken were females. Adults of both sexes have been taken in both summer and winter in Sarpy County and in summer in Banner and Cherry counties.

Of nine pregnant females obtained on July 1, 2, and 4, 1957, in Sioux County, one contained two embryos and each of the others one. Four of five pregnant females taken on June 18-23, 1936, by R. H. Coleman in Cherry County carried two embryos; the fifth carried one. Small, non-flying young were taken in Cherry County on July 14, 1957. Two young bats, one shot and one taken in a net on July 20, 1959, in a canyon of the Wildcat Hills, Banner County, provide the earliest date that I know of on which flying young of the year have been taken. Several lactating females were obtained at the same place. O. L. Webb found a lactating female with two large young 15 mi. N Rushville on September 5, 1951.

According to Engles (1936:658) adult females of this species average four to five per cent larger than adult males and this appears to be true of Nebraskan specimens that I have seen.

Eptesicus fuscus fuscus (Palisot de Beauvois)

Vespertilio fuscus Palisot de Beauvois, Catalogue raisonné du muséum de Mr. C. W. Peale, Philadelphia, p. 18 (p. 14 of English edition by Peale and Palisot de Beauvois), 1796 (type locality, Philadelphia, Philadelphia Co., Pennsylvania); Swenk, Proc. Nebraska Acad. Sci., 8:139, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:83, September, 1908 (part).

[Eptesicus] fuscus, Méhely, Magyarország denevéreinek monographiája (Monographia Chiropterorum Hungariae), pp. 208, 338, 1900.

Vespertilio arquatus Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:167, 1823 (type locality, Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun, Washington Co.], Nebraska).

[Vespertilio] Carolinus [sic], James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Scotophilus carolinensis, H. Allen, Smiths. Misc. Coll., 7(165):28, June, 1864 (part).

Scotophilus fuscus, H. Allen, Smiths. Misc. Coll., 7(165):31, June, 1864 (part).

Adelonycteris fuscus, H. Allen, Bull. U. S. Nat. Mus., 43:112, March 14, 1894.

Eptesicus fuscus fuscus, Swenk, Nebraska Blue Book, p. 854, 1915 (part); Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:276, May 31, 1952; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:482, April 21, 1954; Hall and Kelson, The mammals of North America, p. 186, March 31, 1959.

Eptesicus fuscus, Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920.

Eptesicus fuscus pallidus, Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:227, May 31, 1952 (part).

E[ptesicus]. f[uscus]. fuscus, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Eastern part of state, west certainly to Adams and Knox counties. See Fig. 14.

External measurements.—Average and extreme measurements of 10 specimens (five males, five females) from ½-1 mi. W Meadow are: 121.0 (112-130); 46.4 (40-50); 11.2 (9-12); 18.5 (17-20); 45.3 (42.7-49.0). One December-taken female weighed 22.0 grams. Two October-taken males from 4½ mi. E Red Cloud weighed 25.8 and 24.8 grams; 28 females from the same series weighed an average of 28.1 (21.0-33.0) grams. For cranial measurements see Table 6.

Remarks.—From *Eptesicus fuscus pallidus,* geographically adjacent to the west in Nebraska, *E. f. fuscus* differs in conspicuously darker pelage, especially dorsally, and, in the specimens that I have seen, in average larger external and cranial size (see external measurements and Table 6).

Specimens of *Eptesicus fuscus* from most localities in Nebraska are easily assignable on the basis of color alone to one or the other subspecies, *fuscus* or *pallidus.* There is, however, some variation in color among bats from the same locality. For example, a few specimens of *E. f. fuscus* from Cass and Sarpy counties are paler than the others from there and approach in color the darkest specimens of *E. f. pallidus* from several localities in western Nebraska. Specimens in the series from 4½ mi. E Red Cloud range in color from that typical of *pallidus* to that typical of *fuscus* and are judged to be intergrades between the two subspecies. In external and cranial size the specimens are nearer *fuscus,* to which they are here assigned.

A record of the big brown bat from Neligh (Cary, MS) is referred to *E. f. fuscus* on geographic grounds; a record from Funk (Swenk, MS) is referred to *E. f. pallidus* on similar grounds.

Records of occurrence.—Specimens examined, 98, as follows: ADAMS COUNTY: Hastings, 4 (2 HM); *no specific locality,* 1 (HM). CASS COUNTY: *1½ mi. NE Louisville,* 4 (2 CNHM); Plattsmouth, 1 (NSM). DIXON COUNTY: Ponca State Park, 2 (UC). KNOX COUNTY: 1 mi. W Niobrara, 1. SARPY COUNTY: ½-1mi. W Meadow, 21 (8 NSM, 1 NGFPC). WEBSTER COUNTY: 4½ mi. E Red Cloud, 64 (4 NSM).

Additional records: ANTELOPE COUNTY: Neligh (Cary, MS). KNOX COUNTY: *Niobrara* (Jones, 1954:482). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], the type locality of *Vespertilio arquatus* Say. WEBSTER COUNTY: *Red Cloud* (Swenk, MS).

Eptesicus fuscus pallidus Young

Eptesicus pallidus Young, Proc. Acad. Nat. Sci. Philadelphia, 60:408, October 14, 1908 (type locality, Boulder, Boulder Co., Colorado).

Eptesicus fuscus pallidus, Miller, Bull. U. S. Nat. Mus., 79:62, December 31, 1912; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Webb and Jones, Univ. Kan-

sas Publ., Mus. Nat. Hist., 5:277, May 31, 1952 (part); Hall and Kelson, The mammals of North America, p. 186, March 31, 1959.

Vespertilio fuscus, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:139, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:83, September, 1908 (part).

Eptesicus fuscus fuscus, Swenk, Nebraska Blue Book, p. 854, 1915 (part).

E[ptesicus]. f[uscus]. pallidus, Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:482, April 21, 1954; Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Western part of state, east certainly to Cherry and Thomas counties, and probably Phelps County. See Fig. 14.

External measurements.—Average and extreme measurements of 10 females from Sioux County are: 117.6 (112-120); 44.2 (41-47); 10.9 (10.5-11); 17.0 (16-18); 44.1 (43.0-45.5). The weights of 10 females from Sioux County averaged 19.9 grams (16.4-28.1). For cranial measurements see Table 6.

Remarks.—For comparison with *Eptesicus fuscus fuscus,* geographically adjacent to the east in Nebraska, see account of that subspecies.

Records of occurrence.—Specimens examined, 122 as follows: Banner County: 9 mi. N, 5 mi. E Harrisburg, 15. Boyd County: 4 mi. N, 2½ mi. W Spencer, 12. Cherry County: *Valentine,* 4 (1 NSM, 3 UNDZ); Ft. Niobrara Nat'l Wildlife Refuge, 4 mi. E Valentine, 37 (2 MVZ, 13 NGFPC, 2 NSM). Dawes County: Chadron, 2 (1 NSM); 10 mi. S Chadron, 1 (UMMZ). Sheridan County: 15 mi. N Rushville, 2. Sioux County: Warbonnet Canyon, 6 (NSM); *Monroe Canyon, 5½ mi. N, 2½ mi. W Harrison,* 3 (NGFPC); *Monroe Canyon, 4 mi. N, 2 mi. W Harrison,* 3 (NSM); ½ mi. N, 11 mi. W Crawford, 3 (NSM); *5½ mi. W Crawford,* 19 (11 NSM); 1 mi. S, 4 mi. W Crawford, 4 (NSM); *3½ mi. N, 1 mi. E Glen,* 1 (NSM); *Glen,* 2 (NSM); *1 mi. S, 4 mi. E Glen,* 2 (NSM); 3 mi. S Glen, 6 (NSM).

Additional records: Phelps County: Funk (Swenk, MS). Thomas County: no specific locality (Smith, 1958:59).

Lasiurus borealis

Red Bat

Lasiurus borealis is one of the commonest bats in Nebraska. The westernmost record that I know of in the state is from Oshkosh (Swenk, MS), but the species may be state-wide in distribution in suitable habitats. It has been recorded from three localities in northeastern Colorado (Warren, 1942:28) but is not on record from Wyoming nor from western South Dakota. No red bats have yet been taken in the Pine Ridge area, despite repeated collecting there, and possibly the species does not occur in the northwestern part of Nebraska.

The red bat roosts in trees and in the western part of the state is more or less limited to urban areas and the few wooded riparian communities. The species is more generally distributed in eastern Nebraska and it is not unusual there to find one or more red bats

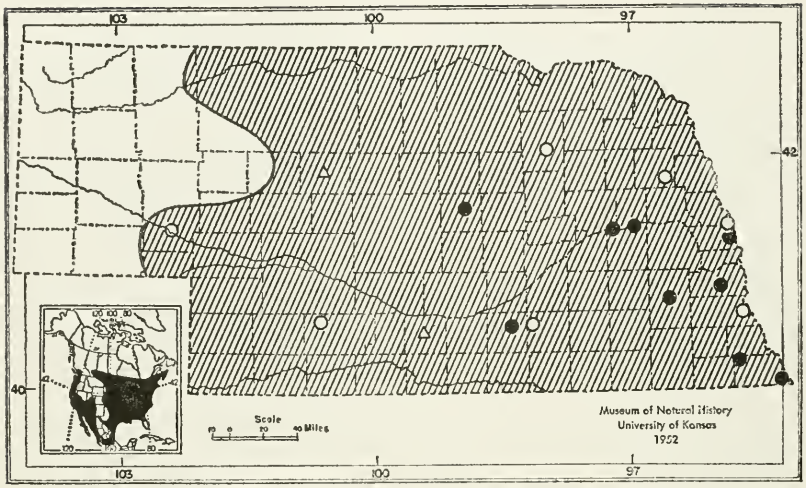

FIG. 15. Distribution of *Lasiurus borealis borealis* in Nebraska. For explanation of symbols see Fig. 5.

inhabiting the small woodlot around a farm home. In most cities and towns in eastern Nebraska, Lincoln for example, red bats are common and can be seen flying among trees in the evening and around street lights after dark. In Lincoln I have found these bats in the daytime most frequently in the exotic Chinese elm, perhaps because they can be more easily seen in Chinese elms than in other trees.

Red bats migrate southward in winter, returning northward again in spring. Females probably migrate northward before males, the latter arriving at about the time of birth of the young. The earliest spring record of the species in Nebraska is of a female taken at Lincoln on April 26, 1951. In many years I have not seen red bats flying in Lincoln until approximately the middle of May.

The number of young ranges from one to four (Cockrum, 1956:497-498); parturition occurs in late May or in June. A female taken 4 mi. N Octavia on May 31, 1957, contained four embryos. A female with three young was obtained at Hastings on June 24, 1924; one with four young was taken at Lincoln on July 5, 1945 (Gates and Wolcott, 1946:84).

Females are dull yellowish brown to buffy chestnut, sometimes slightly frosted with whitish; males are much brighter, usually a bright reddish orange.

Lasiurus borealis borealis (Müller)

Vespertilio borealis Müller, Des Ritters Carl von Linné . . . vollständiges Natursystem . . ., suppl., p. 20, 1776 (type locality, New York).

Lasiurus borealis, Miller, N. Amer. Fauna, 13:105, October 16, 1897; Swenk, Proc. Nebraska Acad. Sci., 8:139, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:83, September, 1908; Cockrum, Trans. Kansas Acad. Sci., 58:496, January 23, 1956.

Vespertilio noveboracensis, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Lasiurus noveboracensis, H. Allen, Smiths. Misc. Coll., 7 (165):15, June, 1864.

Atalapha noveboracensis, H. Allen, Bull. U. S. Nat. Mus., 43:142, March 14, 1894.

Nycteris borealis borealis, Swenk, Nebraska Blue Book, p. 855, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920.

Lasiurus borealis borealis, Gates and Wolcott, Jour. Mamm., 27:84, March 14, 1946; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949; Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:277, May 31, 1952.

L[asiurus]. b[orealis]. borealis, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Known certainly from eastern three-fourths of state; possibly state-wide in suitable habitat. See Fig. 15.

External measurements.—Measurements of two females from Butler County are: 106, 117; 48, 49; 8, 10; 11, 12; 38.8, 40.2. Measurements of a male and female from Lincoln are, respectively: 113, 109; 43, 45; 10, 8; 12, 10; 38.9, 40.6. Measurements of two females from 5 mi. N, 2 mi. W Humboldt are: 117, 111; 50, 49; 9, 9; 14, 14; 37.8, 39.4. A female from Butler County weighed 10.8 grams. For cranial measurements see Table 6.

Records of occurrence.—Specimens examined, 44, as follows: ADAMS COUNTY: Hastings, 5 (HM). BUTLER COUNTY: 2 mi. N, 2 mi. W Bellwood, 1 (NSM); 4 mi. N Octavia, 1. CASS COUNTY: Weeping Water, 1 (NSM). DOUGLAS COUNTY: Omaha, 3 (1 NSM, 2 RV). LANCASTER COUNTY: Lincoln, 26 (2 AMNH, 1 CNHM, 12 NSM, 6 UC, 3 UNDZ). RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 2; Rulo, 1 (WSC); *3 mi. SE Rulo,* 1 (NGFPC). VALLEY COUNTY: Ord, 3.

Additional records: ANTELOPE COUNTY: Neligh (Cary, MS). CLAY COUNTY: Inland (Swenk, MS). CUMING COUNTY: West Point (Swenk, 1908: 139). FRONTIER COUNTY: Curtis (Swenk, MS). GARDEN COUNTY: Oshkosh (Swenk, MS). OTOE COUNTY: Nebraska City (Swenk, 1908:139). PHELPS COUNTY: no specific locality (Swenk, MS). RICHARDSON COUNTY: *Humboldt* (Swenk, 1908:139). THOMAS COUNTY: no specific locality (Smith, 1958:59). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369). County unknown: *"Nebraska"* (H. Allen, 1894: 153).

Lasiurus cinereus

Hoary Bat

The hoary bat is the largest of Nebraskan bats. It occurs throughout the state in suitable habitat but is nowhere abundant. This bat probably arrives in Nebraska earlier in the spring and remains later

in the autumn than most other migratory species. Baker (1954:196) reported a female taken in the northwestern part of Cheyenne County, Kansas, just south of the Nebraska border (Dundy County), on March 26, 1953. Like red bats, *L. borealis,* hoary bats find daytime retreats in trees or shrubs. *L. cinereus* can be easily distinguished from *L. borealis* by brownish upper parts that are frosted with silvery gray and by larger size.

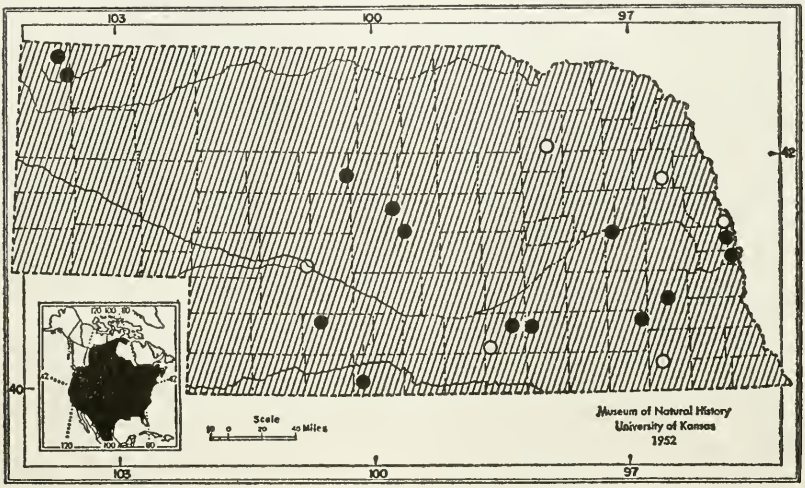

FIG. 16. Distribution of *Lasiurus cinereus cinereus* in Nebraska. For explanation of symbols see Fig. 5.

Females usually bear two young in late May or in June. Females with two embryos have been taken in Nebraska on June 6, 1953, and June 16, 1956. Females with two young have been obtained on June 6, 1957 ("large" young), June 8, 1944, June 17, 1942, and June 19, 1957.

Lasiurus cinereus cinereus (Palisot de Beauvois)

Vespertilio cinereus (misspelled *linereus*) Palisot de Beauvois, Catalogue raisonné du muséum de Mr. C. W. Peale, Philadelphia, p. 18 (p. 15 of English edition by Peale and Palisot de Beauvois), 1796 (type locality, Philadelphia, Philadelphia Co., Pennsylvania).

Lasiurus cinereus, H. Allen, Smiths. Misc. Coll., 7(165): 21, June, 1864; Miller, N. Amer. Fauna, 13:112, October 16, 1897; Swenk, Proc. Nebraska Acad. Sci., 8:139, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:83, September, 1908; Velich, Jour. Mamm., 35:429, August 20, 1954; Cockrum, Trans. Kansas Acad. Sci., 58:499, January 23, 1956.

Vespertilio pruinosus Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:167, 1823 (type locality, Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun, Washington Co.], Nebraska).

Atalapha cinerea, Dobson, Catalogue of the Chiroptera in the . . . British Museum, p. 272, 1878.

Nycteris cinerea, Swenk, Nebraska Blue Book, p. 855, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920.

Lasiurus cinereus cinereus, Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:277, May 31, 1952; Velich, Jour. Mamm., 39:147, February 20, 1958.

L[asiurus]. c[inereus]. cinereus, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 16.

External measurements.—Average and extreme measurements of five specimens (two males, three females) from Sioux County are: 137.2 (130-142); 55.8 (53-58); 11.6 (11-13); 17.5 (16-20); 54.4 (53.9-55.7). Measurements of a male and female from the vicinity of Halsey are, respectively: 138, 135; 67, 52; 11, 13; 10 (crown), 19; 51.9, 55.5. Weights in grams of the two males and three females from Sioux County are, respectively: 20.0, 24.2, 22.5, 20.3, 33.3. For cranial measurements see Table 6.

Remarks.—Occasional specimens of *L. cinereus* have been reported as lacking the anterior upper premolar, which is minute, peglike, and displaced lingually from the normal tooth-row. A male (NSM 12076) from 1 mi. N and 10 mi. W Crawford lacks this tooth on the right side.

Records of occurrence.—Specimens examined, 33, as follows: ADAMS COUNTY: Hastings, 2 (HM). BUTLER COUNTY: 2 mi. N, 2 mi. W Bellwood, 1. CLAY COUNTY: Inland, 2 (HM). CUSTER COUNTY: Victoria Springs, 1 (UMMZ); Broken Bow, 2 (UMMZ). DOUGLAS COUNTY: Omaha, 4 (RV). FRONTIER COUNTY: Curtis, 1 (AMNH). FURNAS COUNTY: Wilsonville, 1 (HM). LANCASTER COUNTY: *4 mi. W Lincoln,* 1 (NSM); Lincoln, 7 (5 NSM, 1UC, 1UNDZ). SALINE COUNTY: Crete, 1 (UC). SARPY COUNTY: Bellevue, 1 (RV). SIOUX COUNTY: 1 mi. S, 4 mi. W Orella, 1 (NSM); *1 mi. N, 10 mi. W Crawford,* 3 (NSM); 5½ mi. W Crawford, 1 (NSM). THOMAS COUNTY: 1 mi. W Halsey, 1; *Halsey,* 1 (AMNH). County unknown: *Loup Fork,* 1 (USNM); "Nebraska," 1 (USNM).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). ANTELOPE COUNTY: Neligh (Cary, MS). CUMING COUNTY: West Point (Swenk, 1908:139). GAGE COUNTY: Beatrice (Swenk, 1908:139). LINCOLN COUNTY: North Platte (Swenk, MS). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], the type locality of *Vespertilio pruinosus* Say.

Nycticeius humeralis

Evening Bat

The evening bat reaches the northwestern limit of its geographic distribution in Nebraska. It is known with certainty from only one locality although the species surely occurs elsewhere in wooded areas in the southeastern part of the state.

Two of these bats were shot on June 1, 1957, over an arm of a sand pit lake in the valley of the Platte River, 2 mi. N and 2 mi. W Bellwood. Two additional specimens were obtained at the same place on June 29, 1957. Probably evening bats seek daytime refuge

primarily in hollow trees and under loose strips of bark but they are known to inhabit buildings on occasion. Presumably this species migrates southward from Nebraska in winter.

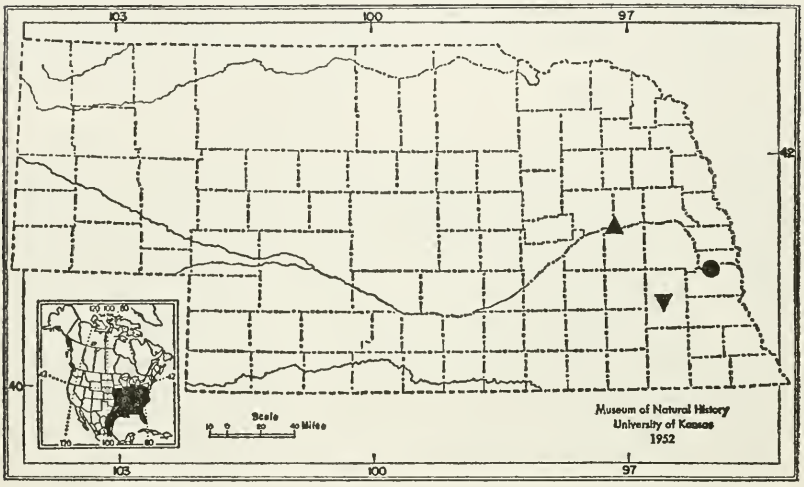

FIG. 17. Records of occurrence of three species of bats in Nebraska. *Pipistrellus subflavus subflavus* (circle). *Nycticeius humeralis humeralis* (triangle). *Tadarida brasiliensis mexicana* (inverted triangle). Inset map shows distribution of *N. humeralis* in North America.

H. Allen (1864:14 and 1894:136) listed a specimen from "Nebraska" (USNM 5322) that was obtained by J. G. Cooper in 1857. Probably this specimen was from some place in the Blue River drainage in the southeastern part of the state. According to records at the U. S. National Museum it was traded to the British Museum in 1866, but no other data are now available concerning it.

The two specimens previously mentioned that were taken on June 1, 1957, both were females and each contained two embryos. The number of young varies from one to four according to Cockrum (1956:499). The two specimens collected on June 29, 1957, also were females but neither was pregnant nor lactating.

Nycticeius humeralis humeralis (Rafinesque)

Vespertilio humeralis Rafinesque, Amer. Monthly Mag., 3(6):445, October, 1818 (type locality, Kentucky).

N[ycticeius]. humeralis, Rafinesque, Jour. Phys. Chim. Hist. Nat. et Arts, Paris, 88:417, June, 1819.

Nycticejus crepuscularis, H. Allen, Smiths. Misc. Coll., 7(165):12, June, 1864.

Nycticejus humeralis, H. Allen, Bull. U. S. Nat. Mus., 43:132, March 14, 1894.

Nycticeius humeralis humeralis, Jones and Vaughan, Jour. Mamm., 40:246, May 20, 1959.

Distribution in Nebraska.—Known only from a single locality in Butler County; probably in wooded areas throughout southeastern part of state. See Fig. 17.

External measurements.—Average and extreme measurements of four females from Butler County are: 94.0 (92-96); 36.2 (35-39); 8.5 (8-9); 13.2 (13-14); 35.9 (35.1-36.3). Two females weighed 12.4 and 12.5 grams. For cranial measurements see Table 6.

Remarks.—The evening bat superficially resembles *Myotis lucifugus lucifugus* but can be readily distinguished from the latter by a much shorter tragus that is rounded distally, richer and darker coloration, much broader and flatter skull, and in having 30 rather than 38 teeth.

Records of occurrence.—Specimens examined, 4, as follows: BUTLER COUNTY: 2 mi. N, 2 mi. W Bellwood, 4 (2 NSM).

Family MOLOSSIDAE—Free-tailed Bats

Tadarida brasiliensis

Brazilian Free-tailed Bat

Only three specimens of this bat have been collected from Nebraska. All of these were obtained in downtown Lincoln as follows: a male on August 15, 1913; a female on June 27, 1931; and a male on August 27, 1956. The two August-taken males were young of the year as evidenced by their unworn teeth and may have wandered northward after leaving breeding colonies someplace to the south or southwest of Nebraska. The female, on the other hand, was at least one year old, was pregnant, and gave birth to a single young the day following capture.

Tadarida brasiliensis is a colonial species, inhabiting principally caves or buildings. It is migratory throughout at least most of its range in the United States. Possibly there are colonies of this bat in extreme southern Nebraska but the breeding colony presently known to be nearest Nebraska is in Woods County, Oklahoma, along the Kansas-Oklahoma border. All the localities of record of the species in the northern half of Kansas (see Cockrum, 1952:84) are represented by single specimens taken late in the year (August to October). I judge that these, like the Nebraskan specimens, represent individuals that wandered north of the usual range of the species.

The occurrence in Nebraska is the northernmost for the species in North America save for parts of Nevada and Oregon.

TABLE 6.—CRANIAL MEASUREMENTS OF SEVEN SPECIES OF BATS.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Condylobasal length	Zygomatic breadth	Interorbital breadth	Breadth of braincase	Length of maxillary tooth-row	Length of mandibular tooth-row
Lasionycteris noctivagans, Lincoln, Lancaster County							
175428 AMNH, ♂	15.8	15.3	....	4.3	8.6	5.8	7.2
Pipistrellus subflavus subflavus, ½ mi. W Meadow, Sarpy County							
Average 10 (6♂, 4♀)	13.1	12.0	8.0	3.6	6.9	4.3	5.8
Minimum	12.6	11.7	7.5	3.4	6.7	4.1	5.5
Maximum	13.4	12.4	8.4	3.8	7.2	4.5	6.0
Eptesicus fuscus fuscus, ½–1 mi. W Meadow, Sarpy County							
Average 10 (5♂, 5♀)	19.8	18.2	13.0	4.5	10.1	7.2	8.8
Minimum	18.9	17.4	12.2	4.3	9.5	7.0	8.6
Maximum	21.3	19.4	13.6	4.7	10.7	7.5	9.1
Eptesicus fuscus pallidus, 5½ mi. W Crawford, Sioux County							
Average 10 (♀)	19.0	18.0	12.4	4.4	9.8	7.0	8.5
Minimum	18.3	17.6	12.0	4.2	9.5	6.6	8.2
Maximum	19.4	18.5	12.9	4.7	10.3	7.4	8.8
Lasiurus borealis borealis, Butler County							
12075 NSM, ♀	13.2	12.5	9.9	4.3	8.1	4.7	6.2
73204 KU, ♀	13.8	13.1	10.1	4.4	8.1	4.9	6.3
5 mi. N, 2 mi. W Humboldt, Richardson County							
79046 KU, ♀	13.6	12.8	10.1	4.2	8.2	4.8	6.3
79047 KU, ♀	13.4	13.1	9.8	4.2	7.9	4.6	6.3
Lasiurus cinereus cinereus, 1 mi. S, 4 mi. W Orella, Sioux County							
12079 NSM, ♀	18.1	16.9	13.1	5.3	10.5	6.4	8.3
Lincoln, Lancaster County							
12081 NSM, ♀	18.2	16.7	13.2	5.4	10.6	6.3	8.1
2 mi. N, 2 mi. W Bellwood, Butler County							
73205 KU, ♀	18.1	16.8	12.5	5.3	10.4	6.4	8.2
Nycticeius humeralis humeralis, 2 mi. N, 2 mi. W Bellwood, Butler County							
Average 4 (♀)	14.8	13.7	10.1	4.1	8.3	5.3	6.7
Minimum	14.2	13.4	10.0	4.0	8.2	5.0	6.5
Maximum	15.1	14.1	10.3	4.2	8.5	5.5	6.9
Tadarida brasiliensis mexicana, Lincoln, Lancaster County							
4136 NSM, ♀	16.8	15.7	9.7	3.8	9.4	5.9	6.9
12437 NSM, ♂	16.5	15.3	9.5	3.9	9.0	5.9	7.0
176105 AMNH, ♂	16.7	15.5	9.7	4.1	9.1	6.0	7.4

Tadarida brasiliensis mexicana (Saussure)

Molossus mexicanus Saussure, Revue et Mag. Zool., Paris, ser. 2, 12:283, July, 1860 (type locality restricted to Cofre de Perote, 13,000 ft., Veracruz, by Elliot, Field Columb. Mus., Publ. 95, Zool. Ser., 4:629, 1904—see Benson, Jour. Washington Acad. Sci., 34:159, May 15, 1944).

Tadarida brasiliensis mexicana, Schwartz, Jour. Mamm., 36:108, February 28, 1955; Hall and Kelson, The mammals of North America, p. 206, March 31, 1959.

Nyctinomus mexicanus, Zimmer, Science, 38 (n. s.):665, November 7, 1913; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:21, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920.

Tadarida mexicana, Webb and Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:278, May 31, 1952.

T[adarida]. b[rasiliensis]. mexicana, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Known only from Lincoln, Lancaster County; possibly occurs elsewhere in southern part of state. See Fig. 17.

External measurements.—Measurements of two males and a female from Lincoln are, respectively: 101, 108, 102; 35, 30, 38; 9 (dry), 10, 10 (dry); 14 (crown), 18, 16; ____, 42.5, 42.8. The weight varies from 8.3-14.4 grams according to Hall (1955:51). For cranial measurements see Table 6.

Records of occurrence.—Specimens examined, 3, as follows: LANCASTER COUNTY: Lincoln, 3 (1 AMNH, 2 NSM).

Order LAGOMORPHA—Hares, Rabbits and Pikas

Four species of lagomorphs—two species of the genus *Lepus* and two species of the genus *Sylvilagus*—are native to Nebraska. Classically, the members of the genus *Lepus* are hares because their young are precocial whereas members of the genus *Sylvilagus* are rabbits because their young are altricial.

KEY TO NEBRASKAN LAGOMORPHS

1. Ear from notch more than 90; greatest breadth of mesopterygoid fossa more than 8.5; interparietal fused with parietals.....2
1′. Ear from notch less than 75; greatest breadth of mesopterygoid fossa less than 8.5; interparietal not fused with parietals.....3
2(1). Dorsum of tail entirely black; mesopterygoid fossa relatively narrow, usually less than 11.0; enamel infolding on anterior face of upper incisor bifurcated or trifurcated.....*Lepus californicus*, p. 109
2′. Dorsum of tail entirely white, or having thin, median pencil of black; mesopterygoid fossa relatively broad, usually more than 11.5; enamel infolding on anterior face of upper incisor a simple groove. *Lepus townsendii*, p. 111
3(1′). Total length more than 460; length of ear from notch more than 71; greatest length of skull more than 80.....*Oryctolagus cuniculus*, p. 331
3′. Total length less than 460; length of ear from notch less than 71; greatest length of skull less than 80.....4
4(3′). Ear long, 62 or more from notch; auditory bullae large, length more than 11.5; external auditory meatus large, external diameter 5.2 or more (usually more than 5.5).....*Sylvilagus audubonii*, p. 102
4′. Ear short, 61 or less from notch; auditory bullae small, length less than 10.5; external auditory meatus small, external diameter 5.3 or less (usually less than 5.0).....*Sylvilagus floridanus*, p. 104

Family LEPORIDAE—Hares and Rabbits

Sylvilagus audubonii

Desert Cottontail

In Nebraska the desert cottontail is typically an inhabitant of the High Plains and no records of occurrence are presently available from east of that region in southwestern Nebraska. To the north of the Platte River the species is recorded not only from the High Plains but also from southern Sheridan County and Hooker County in the western part of the Sand Hills, and from Valentine on the Crookston Table. Although *audubonii* has successfully penetrated the western part of the Sand Hills, it is uncommon there and the Sand Hills evidently are an effective barrier to eastward movement of the species in northern Nebraska. The loess hills and canyons south of the Platte River may provide an equally effective barrier to eastward dispersal. The absence of *audubonii* from most parts of the Sand Hills is especially noticeable because the eastern cottontail, S. *floridanus*, occurs there primarily in lowland habitats, leaving vast areas of dry, upland habitats where no members of the genus *Sylvilagus* occur.

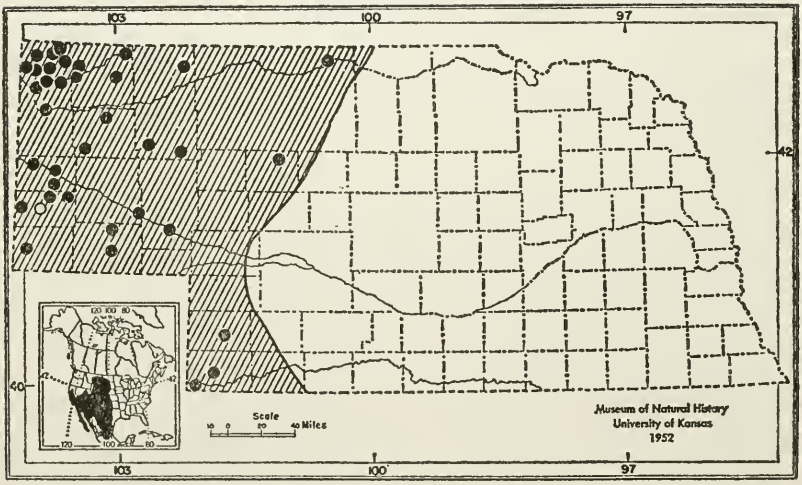

FIG. 18. Distribution of *Sylvilagus audubonii baileyi* in Nebraska. For explanation of symbols see Fig. 5.

Little is known concerning reproduction in the desert cottontail. The only breeding female from Nebraska that I know of is one taken 3 mi. NW Lisco on July 21, 1959, that contained 5 embryos.

Sylvilagus audubonii baileyi (Merriam)

Lepus baileyi Merriam, Proc. Biol. Soc. Washington, 11:148, June 9, 1897 (type locality, Spring Creek, east side Bighorn Basin, Bighorn Co., Wyoming); Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Sylvilagus audubonii baileyi, Nelson, N. Amer. Fauna, 29:232, August 31, 1909; Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920.

Lepus arizonae baileyi, Swenk, Proc. Nebraska Acad. Sci., 8:115, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:59, September, 1908.

Sylvilagus audubonii baileyi, Hall, Univ. Kansas Publ., Mus. Nat. Hist., 5:164, December 15, 1951; Hall and Kelson, The mammals of North America, p. 266, March 31, 1959.

S[ylvilagus]. a[udubonii]. baileyi, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Western two-fifths of state, principally in High Plains region. See Fig. 18.

External measurements.—Average and extreme measurements of eight specimens (four males, four females) from northwestern Nebraska (Dawes and Sioux counties) are: 413.7 (390-435); 45.0 (39-58); 96.4 (90-101); 65.6 (62-69). Average and extreme measurements of seven specimens (five males, two females) from southwestern Nebraska (Chase and Dundy counties) are: 392.0 (378-409); 42.4 (36-51); 93.3 (90-96); 66.3 (62-72). For cranial measurements see Table 7.

Respective weights in grams of three males and three females from Sioux and Dawes counties are: 940, 1040, 1090, 1090, 1230 and 1375.

Remarks.—Specimens of *S. a. baileyi* from the southwestern part of the state average somewhat smaller than those from the northwestern part but do not differ otherwise.

S. a. baileyi is sympatric throughout its range in Nebraska with *Sylvilagus floridanus similis*, although the two species usually occupy different ecological niches. *S. a. baileyi* differs from *S. f. similis* externally in having longer ears and (usually) paler upper parts, especially head, nape and middorsal region; cranially, *baileyi* has larger auditory bullae and external auditory meatuses, shorter toothrows, and ordinarily a narrower mesopterygoid fossa and shorter palatal bridge. The ears of *S. a. baileyi* measured from the notch in fresh specimens are usually 62 mm. or longer (see external measurements). Rarely an individual with ears much shorter than the average is found, as for example one from 15 mi. S Dalton on which the ears measured only 55 mm.

Records of occurrence.—Specimens examined, 113, as follows: BANNER COUNTY: 9 mi. N, 5 mi. E Harrisburg, 2; 10 mi. W Harrisburg, 2 (NSM); Hubbard Gap, 2 (NSM). BOX BUTTE COUNTY: Hemingford, 17 (NSM); about 20 mi. N Bayard, 1 (NSM); *no precise locality*, 4 (NSM). CHASE COUNTY: 3 mi. S Imperial, 1; *2 mi. W Enders*, 1. CHERRY COUNTY: Valentine, 2 (UMMZ). CHEYENNE COUNTY: Dalton, 1 (NSM); 15 mi. S Dalton, 1. DAWES COUNTY: 10 mi. NE Chadron, 1 (USNM); 8 mi. N Crawford, 1 (NSM); Crawford, 6 (NSM); *3 mi. W Crawford*, 3 (NSM); 10 mi. S Chadron, 10 (9 UMMZ, 1 USNM); *15 mi. S Chadron*, 2 (USNM). DUNDY COUNTY:

Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, 6; Haigler, 1 (NSM). GARDEN COUNTY: Oshkosh, 1 (NSM); no precise locality, 1 (NSM). HOOKER COUNTY: Mullen, 1 (UMMZ); *Kelso,* 1 (UMMZ). KIMBALL COUNTY: 1 mi. S Bushnell, 2 (NGFPC). MORRILL COUNTY: 3 mi. NW Lisco, 2. SCOTTS BLUFF COUNTY: 2 mi. W Mitchell, 1 (NSM); *Mitchell,* 1 (NSM); Scottsbluff, 1 (NSM); 6 mi. S, 2 mi. E Gering, 2 (NSM). SHERIDAN COUNTY: Gordon, 3 (NSM); 4-5 mi. N Antioch, 3 (UMMZ); Ellsworth, 1 (UNDZ). SIOUX COUNTY: 21 mi. NW Crawford, 1 (NSM); Montrose, 1; 15 mi. N Harrison, 1 (NSM); Orella, 1 (NSM); *1 mi. S, 4 mi. W Orella,* 2 (NSM); *2 mi. S, 2 mi. W Orella,* 2 (NSM); *Toadstool Park, near Orella,* 6 (NSM); *10 mi. N Harrison,* 1 (NSM); *Warbonnet Canyon,* 3 (NSM); E ½, sec. 21, T. 33 N, R. 54 W, 1 (NSM); head of Warbonnet Creek, 1 (CM); West Monroe Canyon, N of Harrison, 1 (NSM); Andrews, 1 (NSM); Glen, 1 (NSM); *1 mi. S, 4 mi. W Glen,* 1 (NSM); 9 mi. S, 2 mi. E Harrison, 1; 6 mi. E Agate, 2 (UMMZ); *8 mi. E Agate,* 1 (NSM); *western part of county,* 1 (NSM).

Additional record: BANNER COUNTY: Harrisburg (Gates, 1945:10).

Sylvilagus floridanus

Eastern Cottontail

In eastern Nebraska this species seemingly occurs in all terrestrial habitats; ordinarily it is one of the commonest mammals and almost invariably the species most evident to man. In central Nebraska (the Sand Hills to the north and loess hills to the south) *S. floridanus* also is common but is somewhat restricted ecologically because it is found there principally in or near agricultural and riparian communities. In the western part of the state, where it is sympatric with the desert cottontail (*S. audubonii*), *floridanus* usually is restricted, sometimes sharply so, to riparian communities, with *audu-*

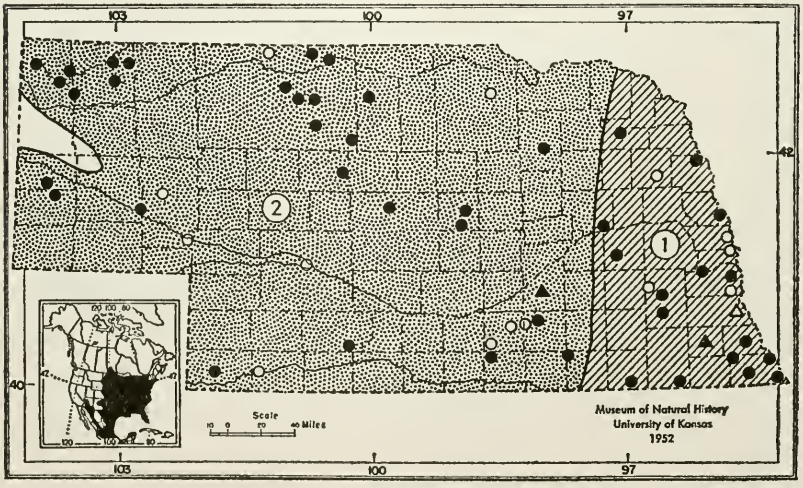

FIG. 19. Distribution of *Sylvilagus floridanus* in Nebraska. 1. *S. f. mearnsii.* 2. *S. f. similis.* For explanation of symbols see Fig. 5.

bonii occupying adjacent uplands. Along Rock Creek in Dundy County, for example, I found *floridanus* restricted to the narrow valley (sometimes 100 yards or less in width) and overlapping *audubonii* only at the valley edges. Along Deadmans Creek in Dawes County and Soldier Creek in eastern Sioux County *floridanus* is similarily restricted. In other places, where a relatively broad transition exists between riparian and upland communities, for example in the Pumpkin Creek valley in Banner County and along the Platte River in the vicinity of Lisco, the two species overlap broadly in the transition area.

The eastern cottontail is subject to year to year fluctuations in population levels and probably also to long-term cyclic fluctuations. Population levels may vary also in different areas at the same time.

Some mammalogists have suspected (see for example Hall and Kelson, 1959:261, fig. 185) that Nuttall's cottontail, S. *nuttallii,* occurs in extreme northwestern Nebraska. S. *floridanus* and S. *nuttallii* have similar ecological requirements and the two species are evidently, therefore, mutually exclusive geographically. S. *floridanus* is widely distributed, although in restricted habitat, in Sioux County and I suspect that the western species, *nuttallii,* does not occur there.

The eastern cottontail is polyestrous and breeds from mid-January to August according to Asdell (1946:205). Eight pregnant females from Nebraska that were obtained in the months of May through July had an average embryo count of 6.4 (3-10). Lactating females have been taken in May, July and August.

Velich (1956:271-272, 1958:148, and 1961:92) reported melanistic S. *floridanus* from several places in eastern Nebraska, but especially from the DeSoto Bend area of Washington County, where a population containing many melanistic individuals evidently exists. I have examined one albino eastern cottontail (from Johnson County), which had pinkish eyes according to the specimen label even though there was a small patch of buffy brown on the nose and the tail was fringed with brownish gray. Velich (1954:429) reported an albino from Sarpy County.

Sylvilagus floridanus mearnsii (J. A. Allen)

Lepus sylvaticus mearnsii, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:171, May 31, 1894 (type locality, Fort Snelling, Hennepin Co., Minnesota).

Sylvilagus (Sylvilagus) floridanus mearnsi, Lyon, Smiths. Misc. Coll., 45:336, June 15, 1904.

?*Lepus Americanus,* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823.

Lepus sylvaticus, Hayden, Trans. Amer. Philos. Soc. 12(n.s.):148, 1863.

L[epus]. sylvaticus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Lepus floridanus mearnsii, Swenk, Proc. Nebraska Acad. Sci., 8:114, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:58, September, 1908.

Sylvilagus floridanus mearnsi, Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Whelan, Trans. Kansas Acad. Sci., 39:366, 1937; Velich, Jour. Mamm., 35:429, August 20, 1954; Velich, Jour. Mamm., 37:272, June 9, 1956; Velich, Jour. Mamm., 39:148, February 20, 1958; Velich, Jour. Mamm., 42:92, February 20, 1961.

Sylvilagus floridanus, Haecker, Nebraska Bird Rev., 9:10, 1941.

S[ylvilagus]. f[loridanus]. mearnsii, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Eastern fourth of state, west certainly to Butler, Jefferson, and Wayne counties. See Fig. 19.

External measurements.—Average and extreme measurements of eight specimens (two males, six females) from Richardson County are: 419.2 (408-432); 46.2 (36-65); 96.6 (90-103); 58.1 (55-61). For cranial measurements see Table 7.

Two females from Richardson County, both November-taken, weighed 2¼ and 2¾ lbs. Four February-taken specimens from Lincoln, a male and three females, weighed respectively: 2 lbs. 1 oz., 2 lbs. 11 oz., 2 lbs. 12 oz., and 2 lbs. 7 oz.

Remarks.—From *Sylvilagus floridanus similis*, geographically adjacent to the west in Nebraska, *S. f. mearnsii* differs in having distinctly darker upper parts, especially a middorsal suffusion of blackish, but also darker face, ears, nape (noticeably more rufous), chest, sides, flanks, rump, and upper side of tail; frequently, too, the upper surface of the feet is darker. The color differences between the two subspecies are best marked in fresh winter pelage. I can detect no reliable cranial differences between *mearnsii* and *similis* and my data fail to support Nelson's (1909:173) contention that *similis* is smaller than *mearnsii*.

Specimens from Butler, Jefferson, and Wayne counties are somewhat paler than typical *mearnsii* and are intergrades with *similis*. A May-taken specimen from 3 mi. S and ½ mi. W Endicott, when compared with five May-taken *similis* from 4 mi. E Valentine, is darker than four and essentially the same color as the fifth; a May-taken specimen from 4 mi. E Rising City is darker than any of the five specimens from Valentine. A skull only from Columbus is provisionally assigned to *mearnsii* on geographic grounds.

The geographic range ascribed to *S. f. mearnsii* in Nebraska is in accord with the range associated with that subspecies in Kansas

by Cockrum (1952:103), who assigned specimens from Washington County to *mearnsii*, and with Findley's (1956*b*:39) assignment to *mearnsii* of specimens from Clay County, South Dakota.

Records of occurrence.—Specimens examined, 52, as follows: BURT COUNTY: Decatur, 1 (NSM). BUTLER COUNTY: 4-5 mi. E Rising City, 10; *5 mi. E, ½ mi. S Rising City,* 3. CASS COUNTY: South Bend, 1 (NSM); Murray, 1 (RV). GAGE COUNTY: 2 mi. S, ½ mi. E Barnston, 1. JEFFERSON COUNTY: 3 mi. S, ½ mi. W Endicott, 1. JOHNSON COUNTY: no precise locality, 1 (NGFPC). LANCASTER COUNTY: 1 mi. N Lincoln, 5 (3 NGFPC, 2 NSM); *¼ mi. N Lincoln,* 1 (NSM); *Lincoln,* 7 (1 NSM, 4 UC, 2 UNDZ); *2 mi. E Lincoln,* 1 (UC); *1 mi. S College View (Lincoln),* 1 (UC); *3½ mi. S, 1 mi. E Lincoln,* 1 (UC); *7 mi. S, 1 mi. E Lincoln,* 2 (UC); Hanlon, 1 (NSM). NEMAHA COUNTY: Auburn, 2 (NGFPC). PLATTE COUNTY: Columbus, 1 (RV). RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 1; 4 mi. E Barada, 5; 3½ mi. S, 1 mi. W Dawson, 2; 3 mi. S Rulo, 1. WASHINGTON COUNTY: DeSoto, 1 (RV). WAYNE COUNTY: 4 mi. SE Carroll, 1 (NSM).

Additional records: CASS COUNTY: Union (Gates, 1945:11). CUMING COUNTY: West Point (Swenk, MS). DOUGLAS COUNTY: Elmwood Park, Omaha (Velich, 1958:148); *near Irvington* (Haecker, 1941:10). LANCASTER COUNTY: Malcolm (Gates, 1945:12); *9 mi. NW Lincoln* (Whelan, 1937:366); *3 mi. S, 2 mi. W Lincoln* (Velich, 1961: 92). NEMAHA COUNTY: *7 mi. SW Auburn* (Velich, 1958:148). OTOE COUNTY: Missouri River bottoms (Velich, 1956:272). SARPY COUNTY: Fontanelle Forest (Velich, 1954:429).

Sylvilagus floridanus similis Nelson

Sylvilagus floridanus similis Nelson, Proc. Biol. Soc. Washington, 20:82, July 22, 1907 (type locality, Valentine, Cherry Co., Nebraska); Lyon and Osgood, Bull. U. S. Nat. Mus., 62:36, January 28, 1909; Nelson, N. Amer. Fauna, 29:172, August 31, 1909 (part); Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Poole and Schantz, Bull. U. S. Nat. Mus., 178:220, April 9, 1942; Hall and Kelson, Univ. Kansas Publ., Mus. Nat. Hist., 5:51, October 1, 1951; Hall and Kelson, The mammals of North America, p. 263, March 31, 1959.

Lepus floridanus similis, Swenk, Proc. Nebraska Acad. Sci., 8:115, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:59, September, 1908.

Sylvilagus floridanus mearnsi, Nelson, N. Amer. Fauna, 29:169, August 31, 1909 (part).

S[ylvilagus]. f[loridanus]. similis, Blair, Occas. Papers Mus. Zool., Univ. Michigan, 380:3, June 21, 1938; Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Sylvilagus f[loridanus]. similis, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Sylvilagus florilanus [sic] similis, Hall, Univ. Kansas Publ., Mus. Nat. Hist., 5:159, December 15, 1951.

Distribution in Nebraska.—Western three-fourths of state, east certainly to Antelope and Thayer counties. See Fig. 19.

External measurements.—Average and extreme measurements of 10 specimens (one male, nine females) from Cherry County are: 420.3 (400-452); 50.5 (41-71); 97.5 (83-104); 55.9 (52-61). For cranial measurements see Table 7.

Five females from western Nebraska averaged 1251.2 (1000-1496) grams in weight. A male from Dawes County weighed 3¼ lbs.

Remarks.—For comparison with *Sylvilagus floridanus mearnsii*, geographically adjacent to the east in Nebraska, see account of that subspecies.

Specimens here assigned to S. *f. similis* from Clay, Hamilton, and Thayer counties are slightly darker over-all than topotypes and are intergrades with *mearnsii.*

Nelson (1909:172) assigned three specimens from Cherry County (one from Brownlee and two from Kennedy) to S. *f. mearnsii* although in the same paper he listed seven specimens from the same county, including one from Kennedy, under *similis.* This inconsistency was first noted by Hall and Kelson (1951:51-52), who assigned the specimen from Brownlee to *similis.* They correctly guessed that one of the specimens from Kennedy was the one listed in the U. S. Fish and Wildlife Service files as being in the collection of the University of Nebraska State Museum; actually it is from the Snake River, 11 mi. NW Kennedy, and it is typical of *similis.* The second specimen from Kennedy was judged by Hall and Kelson not to exist at all, but rather that it represented a duplicated card reference to the U. S. National Museum specimen from the Snake River, 11 mi. NW Kennedy.

Records of occurrence.—Specimens examined, 69 as follows: ANTELOPE COUNTY: Neligh, 2 (USNM). BANNER COUNTY: 9 mi. N, 5 mi. E Harrisburg, 1. BROWN COUNTY: Johnstown, 1 (UMMZ). CHERRY COUNTY: Crookston, 1 (UMMZ); Valentine, 4 (1 UMMZ, 3 USNM, including the holotype); *4 mi. E Valentine,* 8; Snake River, 11 mi. NW Kennedy, 2 (1 NSM, 1 USNM); Kennedy, 1 (USNM); 11 mi. E Kennedy, 2; *20 mi. S Valentine,* 1 (UMMZ); *Valentine Nat'l Wildlife Refuge,* 3 (NSM); Brownlee, 1 (USNM); 30 mi. S Wood Lake, 1 (CNHM). CLAY COUNTY: Harvard, 1 (HM). CUSTER COUNTY: ½ mi. E Victoria Springs, 1 (UMMZ). DAWES COUNTY: Chadron, 2 (CSTC); 8 mi. E Chadron, 1; 10 mi. S Chadron, 5 (UMMZ); Deadmans Creek, 7 mi. S, 3½ mi. W Crawford, 3 (NSM). DUNDY COUNTY: Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, 4. FRONTIER COUNTY: 15 mi. SE Stockville, 1 (NSM). HAMILTON COUNTY: no precise locality, 1 (HM). MORRILL COUNTY: 3 mi. NW Lisco, 2. ROCK COUNTY: *Johnson Ranch, Skull Creek,* 3 (AMNH). SCOTTS BLUFF COUNTY: 7 mi. S Gering, 1; *8 mi. S, 2 mi. E Gering,* 1 (NSM). SIOUX COUNTY: *Warbonnet Canyon,* 1 (UNDZ); 8 mi. N Harrison, 1 (NSM); *West Monroe Canyon, N of Harrison,* 2 (NSM); *½ mi. N, 10 mi. W Crawford,* 1 (NSM); 5½ mi. W Crawford, 1 (NSM); Glen, 1 (NSM). THAYER COUNTY: Davenport, 1 (UNDZ). THOMAS COUNTY: 1 mi. S, 3½ mi. W Halsey, 1. VALLEY COUNTY: 2 mi. S, 4 mi. E Ord, 1; 10 mi. S Ord, 4 (NGFPC). WEBSTER COUNTY: Bladen, 1 (HM).

Additional records (Swenk, MS, unless otherwise noted): ADAMS COUNTY: Hastings; Logan Twp. CHERRY COUNTY: Cody (Cary, MS). CLAY COUNTY: Inland. GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945: 272); Ash Hollow, 3 mi. SE Lewellen (Champe, 1946:44, archeological site). HITCHCOCK COUNTY: Stratton (Seton, 1929, 4:787). HOLT COUNTY: Redbird Creek, N of O'Neill (Seton, 1929, 4:787). LINCOLN COUNTY: near North Platte.

Lepus californicus

Black-tailed Jackrabbit

The black-tailed jackrabbit is state-wide in distribution but the species is much more abundant in the southern part of the state. Its gradual replacement of the white-tailed jackrabbit over much of Nebraska is discussed in the account of *L. townsendii.*

Possibly *L. californicus* did not occur at all in Nebraska 100 years ago. Early travelers along the Platte River, where *californicus* is common today, collected only white-tailed jackrabbits. Even as late as 1909 Nelson, who revised the North American rabbits, had no Nebraskan specimens of *californicus* available for examination, although he (1909:127, fig. 10) mapped a large part of the state as being within the range of the subspecies *L. c. melanotis.* Probably the larger *L. townsendii* was more successful than *L. californicus* on the open prairie; the reverse appears true in regard to lands cultivated for agricultural pursuits.

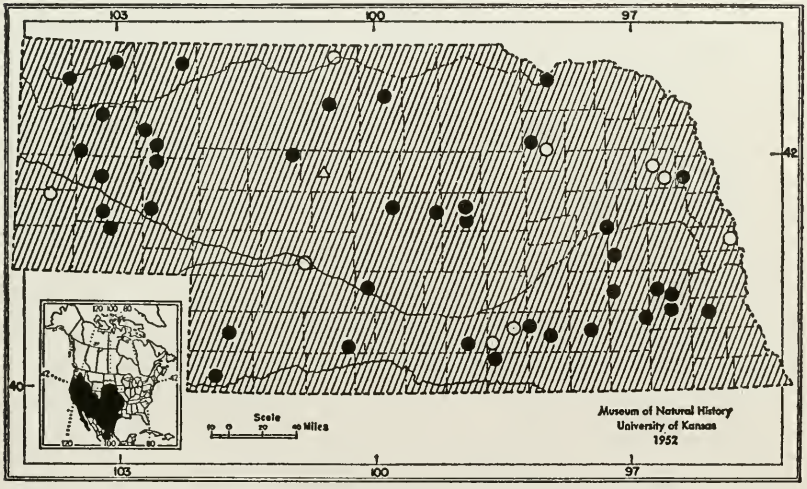

FIG. 20. Distribution of *Lepus californicus melanotis* in Nebraska. For explanation of symbols see Fig. 5.

Merrit Cary (1902:65, 68, 69) recorded *L. melanotis* in the Pine Ridge country of northern Sioux County as early as 1900 and 1901 but did not record *L. townsendii* there. Because Cary preserved no jackrabbits as scientific specimens I cannot now verify this report. It should be noted, however, that all other available evidence suggests that the black-tailed jackrabbit probably had not reached the

extreme northwestern part of the state by 1900; even today the species is uncommon there, far surpassed in numbers by *L. townsendii.*

A female obtained 4 mi. E Rising City on June 1, 1957, contained 6 embryos. Bronson and Tiemeier (1958:411) reported pregnant females from Kansas in every month from January through August and an average of 2.6 embryos (1-5) for 32 pregnancies.

Lepus californicus melanotis Mearns

Lepus melanotis Mearns, Bull. Amer. Mus. Nat. Hist., 2:297, February 21, 1890 (type locality, vicinity of Independence, Montgomery Co., Kansas—type specimen purchased in market in New York City where it had been received from Independence, Kansas, along with several hundred other jackrabbits that were probably obtained "on the northern border of Indian Territory" according to Mearns, *op. cit.*:298); Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Lepus californicus melanotis, Nelson, N. Amer. Fauna, 29:146, August 31, 1909; Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Whelan, Trans. Kansas Acad. Sci., 39:366, 1937; Hall, Univ. Kansas Publ., Mus. Nat. Hist., 5:185, December 15, 1951; Hall and Kelson, The mammals of North America, p. 284, March 31, 1959.

Lepus callotis, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Lepus texianus melanotis, Swenk, Proc. Nebraska Acad. Sci., 8:114, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:58, September, 1908.

L[epus]. c[alifornicus]. melanotis, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—State-wide, but more common in southern part. See Fig. 20.

External measurements.—Average and extreme measurements of 10 specimens (four males, six females) from the vicinity of Rising City are: 568.4 (535-585); 76.3 (71-87); 130.5 (128-134); 118.5 (112-125). For cranial measurements see Table 7.

Bronson (1958:109) reported the average weights of 219 adult males and 212 adult females from Kearny County, Kansas, as 90.9 oz. (5.68 lbs.) and 102.8 oz. (6.42 lbs.), respectively.

Records of occurrence.—Specimens examined, 173 as follows: ANTELOPE COUNTY: Clearwater, 1 (UMMZ). BOX BUTTE COUNTY: 3 mi. N Hemingford, 1 (NSM); *Hemingford,* 5 (NSM); about 20 mi. N Bayard, 1 (NSM). BROWN COUNTY: Ainsworth, 1 (CNHM). BUTLER COUNTY: Rising City, 1 (RV); *4-5 mi. E Rising City,* 8; *4 mi. E, 2 mi. S Rising City,* 3. BURT COUNTY: Oakland, 1. CHASE COUNTY: 3 mi. S Imperial, 4; *2 mi. W Enders,* 4. CHERRY COUNTY: Valentine Nat'l Wildlife Refuge, 1 (NSM). CHEYENNE COUNTY: Dalton, 2 (NSM). CLAY COUNTY: Inland, 1 (HM); 2 mi. E, 2 mi. S Clay Center, 1 (NGFPC). CUSTER COUNTY: *4 mi. NE Victoria Springs,* 1 (UMMZ); 3 *mi. NE Victoria Springs,* 1 (UMMZ); 1 mi. E Victoria Springs, 1 (UMMZ); *2 mi. E Lillian,* 1 (UMMZ); Comstock, 2 (1 AMNH, 1 NSM). DAWES COUNTY: Chadron, 1 (RV). DAWSON COUNTY: 4 mi. E Gothenburg, 1 (UC). DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 7. FILLMORE COUNTY: 3 mi. N, 1 mi. E Geneva, 1. FRONTIER COUNTY: 15 mi. SE Stockville, 1 (NSM). GARDEN COUNTY: 6 mi. S Antioch, 1 (UMMZ); 5 mi. N Lisco, 1 (NSM). HOOKER COUNTY: *1 mi. W Mullen,* 1 (UMMZ); Kelso, 1 (UMMZ).

Kearney County: 6 mi. S Minden, 2. Knox County: 1½ mi. SE Niobrara, 1 (NGFPC). Lancaster County: T. 10 N, R. 5 E, near Malcolm, 1 (NSM); Lincoln, 6 (3 NSM, 2 RV, 1 UC); *1 mi. S Lincoln*, 1; *4 mi. S Lincoln*, 1 (UC); *6 mi. SW Lincoln*, 1 (UC); 7 mi. S, 1 mi. E Lincoln, 2 (UC). Morrill County: 11 mi. N Bridgeport, 73 (NSM); *Bridgeport*, 9 (NSM); Greenwood Canyon, S of Bridgeport, 5 (NSM). Otoe County: Unadilla, 1 (NSM). Platte County: Columbus, 1 (RV). Saline County: Crete, 3 (2 NSM, 1 RV). Seward County: 12 mi. W Seward, 1 (UC). Sheridan County: Gordon, 1 (NSM); 16 mi. NE Alliance, 1 (UMMZ); 4 mi. N Antioch, 2 (UMMZ). Sioux County: 3 mi. E Glen, 1 (NSM). Valley County: Ord, 1 (NGFPC); 10 mi. S Ord, 1 (NGFPC). Webster County: Bladen, 2 (HM).

Additional records: Adams County: vicinity Hastings (Swenk, MS); Logan Twp. (Swenk, MS). Antelope County: Neligh (Cary, MS). Banner County: 9 mi. N, 3 mi. E Harrisburg (Jones, field notes). Cherry County: Ft. Niobrara Nat'l Wildlife Refuge (Beed, 1936:21). Cuming County: Beemer (Cary, MS); West Point (Swenk, MS). Douglas County: Omaha (Swenk, MS). Lancaster County: *9 mi. NW Lincoln* (Whelan, 1937:366). Lincoln County: vicinity North Platte (Swenk, MS). Sioux County: *northern part* (Cary, 1902:69). Thomas County: no specific locality (Smith, 1958:61).

Lepus townsendii

White-tailed Jackrabbit

The white-tailed jackrabbit formerly occurred over all of Nebraska, excepting possibly the extreme southeastern part, but now is mostly limited to that part of the state north of the Platte River. The most recent record from south of the Platte in eastern Nebraska is a specimen obtained at Weeping Water in January of 1915. The most recent report from south of the Platte in central Nebraska is from Logan Township, Adams County, in 1935. I have no recent records of *L. townsendii* from southwestern Nebraska but local residents (in central Dundy County, for example) report that "a few" still occur there; several specimens have been taken in recent years in the parts of Colorado adjoining southwestern Nebraska.

The gradual disappearance of the white-tailed jackrabbit from southern Nebraska has been accompanied by a northward spread of the smaller black-tailed jackrabbit, *Lepus californicus*. Lawrence Bruner reported (Swenk, MS) that white-tails were abundant in the vicinity of Lincoln "in the early days" [probably the 1890's]; only black-tails occur in this area today. Wilson Tout reported (Swenk, MS) that both species occurred in the vicinity of North Platte in 1915 but that *L. townsendii* was the more common; today the situation is reversed there and black-tails are abundant whereas white-tails are uncommon. Fred Arterburn of Grant reported to Edson Fichter (interview, April 2, 1950) that white-tails were common in Chase and Perkins counties when he first arrived in 1885, that black-tails did not occur there, and that as grassland gave way to cropland, especially corn, black-tails appeared and by 1900 outnumbered

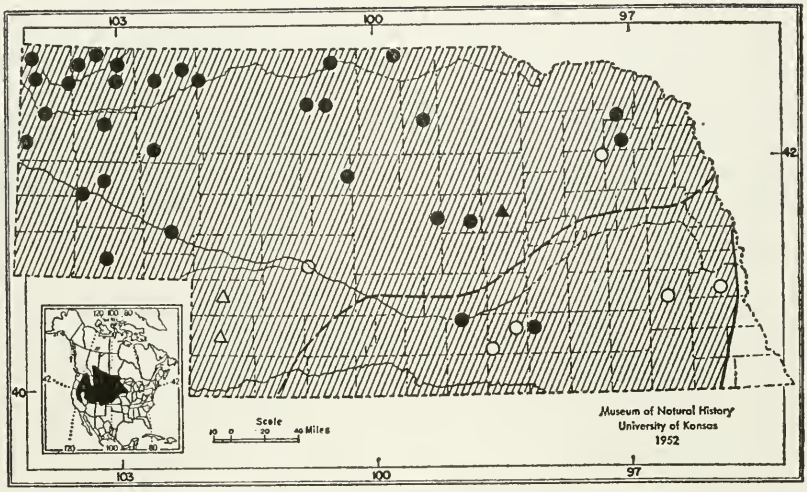

FIG. 21. Distribution of *Lepus townsendii campanius* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate southeastern limit of present distribution.

white-tails; the latter species is rare, possibly entirely absent, in Chase and Perkins counties today. Swenk (1908:113) listed the distribution of *L. townsendii* as: "Entire state, but much more common northwardly where the Black-tail does not occur." Now the latter species is state-wide in distribution. Cockrum (1952:98) has reported corresponding evidence of decrease of *L. townsendii* and increase of *L. californicus* in northwestern Kansas, as has Warren (1942:263, and elsewhere) in northeastern Colorado.

To the north of the Platte the white-tailed jackrabbit still occurs in the loess hills of central Nebraska and in the northeastern part of the state, but in most places is less numerous than *L. californicus*. Even in Thomas County in the Sand Hills black-tails are reported to be more common (Smith, 1958:61). In most parts of the Sand Hills, however, in the extreme northeastern part of the state, and on the High Plains of northwestern Nebraska white-tails still outnumber black-tails. Local residents of eastern Sioux County, who hunted jackrabbits for commercial purposes in the winter of 1956-57, reported that *townsendii* predominated over *californicus* there by the approximate ratio of 10 individuals to one. My own observations in central Cherry County lead me to believe that white-tails outnumber black-tails in that area by an even greater figure, perhaps as much as 20 to one. The breaking up of the prairie for

agricultural purposes has been cited previously (Brown, 1947:456, and others) as the reason for the reduction in numbers or disappearance of the white-tailed jackrabbit in the southern part of its range. Unquestionably the black-tailed jackrabbit survives better in cultivated areas. White-tails are still common, however, in northeastern Nebraska, a section of the state that has been under fairly heavy cultivation for many years. I wonder whether or not temperature has been a factor in limiting the southern distribution of *L. townsendii,* because, in addition to retreat northward from the southern part of its range, the species has expanded its distribution to the north and northeast (see Scott, 1937:81, and Seton, 1929:4, 650-652). Possibly this shift has been in part responsive to the gradual warming trend now in progress on the North American continent.

The pelage of the white-tailed jackrabbit becomes nearly white in winter throughout the present range of the species in Nebraska and according to Swenk (1908:113) formerly did so even along the southern border of the state.

Of two females collected 11 mi. E Kennedy on July 12, 1957, one contained 4 and the other 5 well-developed, fully-haired embryos. A female obtained 1 mi. S and 4 mi. W Crawford, in Sioux County, on August 5, 1957, carried a single embryo that measured 44 mm. in crown-rump length. As many as 6 embryos per female have been reported; only one litter per year is known.

Lepus townsendii campanius Hollister

Lepus campestris Bachman, Jour. Acad. Nat. Sci. Philadelphia, 7:349, 1837 (type locality, plains of Saskatchewan, probably near Carlton House), not Meyer, 1790; Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):585, July 14, 1858; J. A. Allen, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:297, August, 1877; Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880; Elliot, Field Columb. Mus., Zool. Ser. (Publ. 115), 8:385, 1907; Swenk, Proc. Nebraska Acad. Sci., 8:114, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:58, September, 1908; Nelson, N. Amer. Fauna, 29:74, August 31, 1909.

Lepus townsendii campanius Hollister, Proc. Biol. Soc. Washington, 28:70, March 12, 1915, a renaming of *L. campestris* Bachman; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936.

Lepus campestris campestris, Swenk, Nebraska Blue Book, p. 853, 1915.

L[epus]. t[ownsendii]. campanius, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Formerly all of state excepting extreme southeastern part; presently occurring primarily north of Platte River. See Fig. 21.

External measurements.—Measurements of two males and two females from Cherry County are, respectively: 632, 610, 615, 615; 85, 107, 101, 90; 161, 142, 151, 146; 110, 104, 100, 101. Measurements of a male and female from 6 mi. W Rushville are, respectively: 602, 645; 98, 115; 142, 145; 113, 118. For cranial measurements see Table 7.

A male from Dawes County weighed 8 lbs. and one from Sheridan County 6.5 lbs. Two pregnant females from Cherry County weighed 9.0 and 9.25 lbs., whereas one from Sioux County weighed 8 lbs.

Remarks.—Two specimens from Nebraska at the U. S. National Museum, both obtained in 1857, have uncertain data as to locality. The specimen label of one (3058) bears the locality "Platte R. 90 m. at Kearney." I interpret this specimen to be from Ft. Kearney, as did J. A. Allen (*in* Coues and Allen, 1877:302), but Nelson (1909:78) recorded it from "90 miles above Fort Kearney" [Lincoln County]. The other specimen (3133/4130) was recorded by Allen (*op. cit.*) from the "Forks of the Platte" [Lincoln County] but the label now associated with this specimen locates it only as from along the Platte River.

Gates (1945:10, 11) reported (in a paper on fleas and their hosts) *L. t. campanius* as taken in 1944 at Lincoln and at Huntley, Harlan County. Probably both these records relate instead to *L. c. melanotis.*

Records of occurrence.—Specimens examined, 58, as follows: BOX BUTTE COUNTY: Hemingford, 3 (NSM); *no specific locality,* 1 (NSM). CEDAR COUNTY: S of Belden, 1 (NSM). CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge, 1 (NSM); *Valentine,* 1 (USNM); *5 mi. E Valentine,* 1; 10 mi. ESE Gordon, 1 (CNHM); *15 mi. S Valentine,* 1 (UMMZ); Kennedy, 2 (UMMZ); 11 mi. E Kennedy, 3; *Valentine Nat'l Wildlife Refuge,* 1 (NSM). CHEYENNE COUNTY: 15 mi. S Dalton, 1. CLAY COUNTY: Inland, 1 (HM). CUSTER COUNTY: Comstock, 1 (NSM). DAWES COUNTY: Wayside, 1; 11 mi. N Crawford, 1 (NSM); Chadron, 1 (RV); *4 mi. N, 2 mi. W Crawford,* 1 (NSM); 10 mi. S Chadron, 2 (UMMZ); *Crawford,* 4 (NSM). GARDEN COUNTY: Oshkosh, 1 (NSM). GREELEY COUNTY: no specific locality, 1 (HM). KEARNEY COUNTY: Ft. Kearney, 2 (USNM). KEHA PAHA COUNTY: 12 mi. N Springview, 1. MORRILL COUNTY: 11 mi. N Bridgeport, 4 (NSM); Chimney Rock, 1 (RV). ROCK COUNTY: Perch, 3 (1 AMNH, 2 CNHM). SHERIDAN COUNTY: Gordon, 3 (2 NSM, 1 UMMZ); 6 mi. W Rushville, 2 (NGFPC); 4 mi. N Antioch, 1 (UMMZ). SIOUX COUNTY: Warbonnet Canyon, 1 (UNDZ); 1 mi. S Harrison, 1 (UMMZ); *1 mi. W Ft. Robinson,* 1 (NSM); 1 mi. S, 4 mi. W Crawford, 1 (NSM); 6 mi. E Agate, 1 (UMMZ); Spoon Butte, 1 (USNM). THOMAS COUNTY: Halsey, 1 (NSM). VALLEY COUNTY: 10 mi. S, 2 mi. E Ord, 1 (NGFPC). WAYNE COUNTY: 1 mi. W, 2 mi. S Winside, 1. County unknown: *Platte River,* 1 (USNM).

Additional records (Swenk, MS, unless otherwise noted): ADAMS COUNTY: vicinity Hastings; Logan Twp. CASS COUNTY: Weeping Water. CHASE COUNTY: no specific locality (see text). LANCASTER COUNTY: vicinity Lincoln. LINCOLN COUNTY: vicinity North Platte. MADISON COUNTY: vicinity Norfolk. PERKINS COUNTY: no specific locality (see text). County unknown: *Loup Fork* (Nelson, 1909:78).

TABLE 7.—CRANIAL MEASUREMENTS OF FOUR SPECIES OF LAGOMORPHS.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Zygomatic breadth (across squamosals)	Postorbital constriction	Length of maxillary tooth-row	Length of incisive foramen	Breadth of mesopterygoid fossa	Least length of palatal bridge
Sylvilagus audubonii baileyi, Dawes and Sioux counties							
Average 7 (3♂, 4♀)	71.0	35.6	11.5	13.4	17.9	6.1	5.4
Minimum	69.2	34.8	9.8	12.8	17.3	5.7	4.5
Maximum	72.8	37.2	12.7	14.0	18.3	6.5	6.0
Sylvilagus floridanus mearnsii, Richardson County							
Average 7 (2♂, 5♀)	73.0	36.0	11.8	15.0	17.7	6.7	6.8
Minimum	70.8	34.3	10.6	14.3	16.5	5.9	6.2
Maximum	74.8	37.6	14.1	15.5	18.5	7.5	7.6
Sylvilagus floridanus similis, 4 mi. E Valentine, Cherry County							
Average 6 (1♂, 5♀)	72.6	36.0[5]	12.5	15.0	18.2	6.6	6.5
Minimum	70.8	35.6	11.4	14.3	16.6	6.5	5.9
Maximum	75.3	36.4	14.8	15.8	19.2	7.1	6.9
Lepus californicus melanotis, vicinity Rising City, Butler County							
Average 10 (4♂, 6♀)	98.4	44.4	11.4	17.5	25.7	10.3	6.3
Minimum	95.3	41.4	10.1	16.5	23.1	9.5	5.9
Maximum	101.3	45.8	12.8	18.3	27.6	11.6	6.6
Lepus townsendii campanius, Cherry County							
73242 KU, ♀	95.8	46.3	13.2	18.4	25.1	11.7	5.5
73243 KU, ♀	96.7	47.1	13.1	18.3	25.1	13.1	5.0
77931 KU, ♂	99.8	47.2	13.2	19.3	25.6	12.8	4.7

Order RODENTIA—Rodents

As a group, rodents are the most numerous of Nebraskan mammals, both in number of kinds (34 native species) and in number of individuals. Seven families are represented among the indigenous rodents of the state and species of two other families (Capromyidae and Muridae) have been introduced in Nebraska.

KEY TO FAMILIES OF NEBRASKAN RODENTS

1. Modified for aquatic life; hind feet webbed; lower incisor more than 6.0 in width at alveolus.....2
1′. Not especially modified for aquatic life (except *Ondatra*); hind feet not webbed; lower incisor less than 5.5 (less than 4.0 in all except Erethizontidae) in width at alveolus.....3

2(1). Tail flattened dorso-ventrally, its breadth approximately 25 per cent its length; infraorbital canal smaller than foramen magnum. Castoridae, p. 182

2'. Tail not flattened dorso-ventrally, its breadth less than 10 per cent its length; infraorbital canal larger than foramen magnum. Capromyidae, p. 335

3(1'). Quills on dorsum and tail; infraorbital canal larger than foramen magnum.....Erethizontidae, p. 241

3'. Quills lacking; infraorbital canal never larger than foramen magnum.....4

4(3'). Pelage of tail usually distichous; skull having postorbital processes. Sciuridae, p. 116

4'. Pelage of tail non-distichous (excepting *Neotoma cinerea*); skull lacking postorbital processes.....5

5(4'). Cheek-teeth 4/4; external fur-lined cheek pouches present.....6

5'. Cheek-teeth 3/3 or 4/3; external fur-lined cheek pouches lacking...7

6(5). Tail more than three-fourths length of head and body; hind feet larger than forefeet; tympanic bullae exposed on parietal surface of skull.....Heteromyidae, p. 163

6'. Tail less than three-fourths length of head and body; hind feet smaller than forefeet, the latter highly modified for digging; tympanic bullae not exposed on parietal surface of skull.....Geomyidae, p. 151

7(5'). Cheek-teeth 4/3; tail much longer than head and body..Zapodidae, p. 238

7'. Cheek-teeth 3/3; tail short to medium, equal to or less than length of head and body.....8

8(7'). Annulations of scales on tail nearly or completely concealed by pelage (excepting *Ondatra zibethicus*, in which tail is laterally flattened); cheek-teeth having two longitudinal rows of cusps or prismatic. Cricetidae, p. 186

8'. Annulations of scales on tail apparent; cheek-teeth having three longitudinal rows of cusps.....Muridae, p. 331

Family SCIURIDAE—Squirrels and Allies

KEY TO NEBRASKAN SCIURIDS

1. Total length usually more than 540; length of hind foot more than 80; greatest length of skull more than 80; postorbital processes at right angle to long axis of skull.....*Marmota monax*, p. 121

1'. Total length less than 540; length of hind foot less than 80; greatest length of skull less than 70; postorbital processes projecting backward and downward.....2

2(1'). Total length more than 325; length of hind foot more than 50; greatest length of skull more than 50.....3

2'. Total length less than 325; length of hind foot less than 50; greatest length of skull less than 50.....6

3(2). Dorsal pelage yellowish brown to pale brownish; tail having distinct black tip; zygomatic arches strongly divergent posteriorly, breadth more than 40; maxillary tooth-rows strongly divergent anteriorly, length more than 15.....*Cynomys ludovicianus*, p. 136

3'. Dorsal pelage other than yellowish brown to pale brownish; tail lacking distinct black tip; zygomatic arches not strongly divergent posteriorly, breadth less than 40; maxillary tooth-rows more or less parallel, length less than 12.....4

4(3'). Tail less than 40 per cent of total length; P3 well developed; postorbital breadth less than 15.....*Spermophilus franklinii*, p. 124

4'. Tail more than 40 per cent of total length; P3 small and peglike, or absent; postorbital breadth more than 15.....5

5(4′). Tail tipped laterally with whitish; P3 usually present.
Sciurus carolinensis, p. 141

5′. Tail tipped laterally with straw color to reddish orange; P3 absent.
Sciurus niger, p. 144

6(2′). Dorsum striped, but lacking spots; infraorbital canal lacking, the infraorbital foramen piercing zygomatic plate of maxillary; P3 minute and peglike, or lacking.....7

6′. Dorsum lacking stripes, or if striped also having spots; infraorbital canal present; P3 moderately to well developed.....8

7(6). Total length more than 235; greatest length of skull more than 37; P3 absent; occurring only in southeastern Nebraska.
Tamias striatus, p. 117

7′. Total length less than 235; greatest length of skull less than 37; P3 present; occurring only in northwestern Nebraska.
Eutamias minimus, p. 119

8(6′). Hind foot more than 40; maxillary tooth-row more than 10; P3 nearly as large as P4.....*Spermophilus richardsonii*, p. 127

8′. Hind foot less than 40; maxillary tooth-row less than 8; P3 one half or less as large as P4.....9

9(8′). Membrane for gliding present between foreleg and hind leg; skull highly arched, highest over braincase; nasals less than 11.
Glaucomys volans, p. 149

9′. Membrane for gliding lacking; skull only moderately arched, highest over orbits; nasals more than 11.....10

10(9′). Dorsum having dark stripes alternating with pale stripes that contain dark spots; postorbital breadth less than 11.5 and less than length of nasals; length of auditory bullae less than 8.5.
Spermophilus tridecemlineatus, p. 130

10′. Dorsum pale brownish gray, sometimes having indistinct white spots; postorbital breadth more than 11.5, approximately equal to length of nasals; length of auditory bullae more than 8.5.
Spermophilus spilosoma, p. 128

Tamias striatus

Eastern Chipmunk

The eastern chipmunk occurred formerly in southeastern Nebraska along the wooded bluffs of the Missouri River and elsewhere in wooded areas along major tributaries of the Missouri. Early accounts indicate that the species was not uncommon in some places. In the past 40 years, however, it has been taken only at two localities, each along the bluffs of the Missouri River. One of these is the Fontanelle Forest Reserve, south of Omaha in Sarpy County, where a small population of this chipmunk seemingly still persists (Velich, 1947:185-186, 1954:429); the other is Nebraska City, from which the species has been twice recorded. Local residents at Minersville and at Peru informed me in the autumn of 1952 that "a few" eastern chipmunks were still to be found in those areas too, but that the species was seen much less frequently than in the early 1900's. Two residents of Barada reported to me in the autumn of 1956 that they had seen no chipmunks in that

vicinity for many years but that the species was "fairly common" along the bluffs of the Missouri up to about 1920. All the records from Swenk (MS) that are listed beyond, and for which a date is available, are from before the turn of the last century.

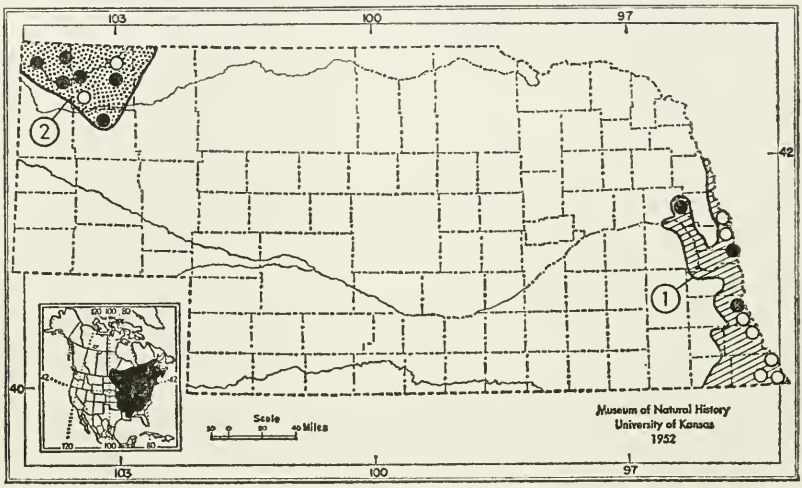

FIG. 22. Distribution of two species of chipmunks in Nebraska. 1. *Tamias striatus griseus*. 2. *Eutamias minimus pallidus*. For explanation of symbols see Fig. 5. Inset map shows distribution of *T. striatus* in North America.

Tamias striatus was first recorded from Nebraska by James (1823: 370) from the Engineer Cantonment in Washington County, the northernmost locality along the Missouri from which the species is certainly known. Hayden (1863:138) found the eastern chipmunk "abundant at Bellevue, Nebraska." He further remarked that it did "not pass above the mouth of the Niobrara; very few are seen above Council Bluffs." The northwesternmost record in the state is provided by a specimen obtained at Nickerson, along the Elkhorn River, in August of 1915.

The eastern chipmunk breeds in spring and frequently again in late summer or early autumn. The number of young usually is 3, 4, or 5 (1-8).

Tamias striatus griseus Mearns

Tamias striatus griseus Mearns, Bull. Amer. Mus. Nat. Hist., 3:231, June 5, 1891 (type locality, Fort Snelling, Hennipen Co., Minnesota); Swenk, Proc. Nebraska Acad. Sci., 8:82, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:26, September, 1908; Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Polder, Proc. Iowa Acad. Sci., 60:722, 1953; Velich, Jour. Mamm., 35:429, August 20, 1954;

Miller and Kellogg, Bull. U. S. Nat. Mus., 205:217, March 3, 1955; Hall and Kelson, The mammals of North America, p. 295, March 31, 1959; Velich, Jour. Mamm., 42:92, February 20, 1961.

[Sciurus] striatus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823.

Tamias striatus, Hayden, Trans. Amer. Philos. Soc., 12(n.s.):138, 1863; Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880; Velich, Jour. Mamm., 24:273, June 8, 1943.

[Tamias striatus] griseus, Velich, Jour. Mamm., 28:185, May 19, 1947.

T[amias]. s[triatus]. griseus, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Formerly along Missouri River and its major tributaries in southeastern part of state, north at least to Washington and Dodge counties; presently rare and limited to a few suitable areas along bluffs of the Missouri. See Fig. 22.

External measurements.—No external measurements of adult eastern chipmunks from Nebraska are available. Average and extreme measurements of eleven topotypes of *T. s. griseus* (after A. H. Howell, 1929:20) are: 268.4 (253-299); 101.3 (93-110); 36.6 (35-38); 13.7 (12-16.5). For cranial measurements see Table 8.

The weight in grams of four specimens (three males, one female) from St. Louis County, Minnesota, averaged 97.7 (88-110).

Records of occurrence.—Specimens examined, 7, as follows: DODGE COUNTY: Nickerson, 1 (HM). OTOE COUNTY: 1 mi. S Nebraska City, 1 (RV). SARPY COUNTY: Fontanelle Forest, 5 (1 HM, 4 RV).

Additional records (Swenk, MS, unless otherwise noted): DOUGLAS COUNTY: *near Omaha;* near Florence. NEMAHA COUNTY: vicinity Peru. OTOE COUNTY: *5 mi. S Nebraska City* (Velich, 1961:92); Minersville (see text). RICHARDSON COUNTY: vicinity Barada (see text); Falls City (Cary, MS); vicinity Rulo. SARPY COUNTY: *Bellevue* (Hayden, 1863:138). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:370); *Rockport.*

Eutamias minimus

Least Chipmunk

The least chipmunk inhabits slopes and canyons of the western part of the Pine Ridge and rocky areas in the badlands to the north of the Pine Ridge. The species is common in some places. Insofar as I know it does not occur in Nebraska east of Pine Ridge, even in seemingly suitable habitat along parts of the Niobrara River, or in the southern part of the Panhandle, where Wildcat Ridge, Bighorn Ridge, and some other places offer possibly suitable habitat.

The species hibernates in winter in Nebraska. Females bear a single litter annually, consisting of 2-6 young, in spring.

Eutamias minimus pallidus (J. A. Allen)

[*Tamias quadrivitatus*] var. *pallidus* J. A. Allen, Proc. Boston Soc. Nat. Hist., 16:289, June, 1874 (type locality restricted to Camp Thorne, near Glendive, Dawson Co., Montana, by Cary, Proc. Biol. Soc. Washington, 19:88, June 4, 1906).

Eutamias minimus pallidus, A. H. Howell, Jour. Mamm., 3:183, August 4, 1922; A. H. Howell, N. Amer. Fauna, 52:42, November 30, 1929; White, Univ. Kansas Publ., Mus. Nat. Hist., 5:261, April 10, 1952; Hall and Kelson, The mammals of North America, p. 302, March 31, 1959.

Tamias quadrivittatus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Tamias minimus, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Eutamias pallidus, Cary, Proc. Biol. Soc. Washington, 19:87, June 4, 1906; Swenk, Proc. Nebraska Acad. Sci., 8:82, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:26, September, 1908 (part).

Eutamias pallidus cacodemus, Swenk, Proc. Nebraska Acad. Sci., 8:83, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:27, September, 1908 (part); Swenk, Nebraska Blue Book, p. 851, 1915 (part); Swenk, Nebraska Blue Book, p. 408, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 480, December, 1920 (part).

Eutamias pallidus pallidus, Swenk, Nebraska Blue Book, p. 851, 1915 (part); Swenk, Nebraska Blue Book, p. 408, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 480, December, 1920 (part).

E[utamias]. m[inimus]. pallidus, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Pine Ridge and adjacent badlands of Sioux and Dawes counties, east at least to the vicinity of Chadron; known also from one locality in Box Butte County. See Fig. 22.

External measurements.—Average and extreme measurements of nine specimens (three males, six females) from Dawes and Sioux counties are: 210.9 (204-215); 96.5 (89-100); 32.3 (31-33); 15.5 (14-17). For cranial measurements see Table 8.

Seven specimens (two males, five females) from 3½ mi. N and 1 mi. E Glen weighed an average of 45.9 grams (42.2-52.1).

Remarks.—In the original description of *Eutamias minimus cacodemus* of the Badlands of South Dakota, Cary (1906:90, footnote) suggested that chipmunks from the badlands of northern Sioux and Dawes counties might be referable to *cacodemus.* Subsequently, Swenk (1908:83, and elsewhere) listed *E. m. cacodemus,* along with *E. m. pallidus,* as occurring in Nebraska. Some chipmunks from the Nebraskan badlands are somewhat paler on the head, back, and sides than chipmunks from the Pine Ridge to the south but are not nearly so pale dorsally and on the underside of the tail as specimens of *E. m. cacodemus* from Jackson, Pennington, and Shannon counties, South Dakota.

Manuscript reports of *E. m. pallidus* from several places in the southern part of the Panhandle have not been admitted here. Cary (MS) recorded the species from Smeed, Kimball County, and from extreme western Banner and Scottsbluff counties, and Swenk (MS) listed it from as far east as Oshkosh, Garden County, along the Platte River. The wide distribution of ponderosa pine and red cedar in the southern Panhandle makes it tempting to assume that

E. minimus occurs there, but I know of no records of occurrence supported by specimens, nor has the occurrence of the species there been reported to me by local residents. It should be noted, however, that White (1953:596) recorded the subspecies *E. m. pallidus* from two counties in Wyoming adjacent to the southern part of the Panhandle. Possibly the occurrence of the least chipmunk to the south of the Pine Ridge at Hemingford, based on a skull only (NSM 723), is open to question.

A specimen reported by J. A. Allen (*in* Coues and Allen, 1877:808) from "Pole [Lodgepole] Creek" (USNM 1907/2605) originated from what is now Wyoming, as probably did another (USNM 4773) listed by him (*loc. cit.*) simply as from "Nebraska." Similarly, four specimens (UMMZ 62653-56) from the "Platte Valley" probably are from Wyoming. A specimen (UMMZ 62640) from the "Head of Loup Fork" almost certainly originated from some other place. The Loup Fork, or Middle Loup River, has its source in the Sand Hills, as do the other branches of the Loup River system, far to the east of the known range of *E. minimus* and in a habitat inhospitable to the species.

Records of occurrence.—Specimens examined, 74, as follows: BOX BUTTE COUNTY: Hemingford, 1 (NSM). DAWES COUNTY: Crawford, 2 (1 AMNH, 1 HM); 10 mi. S Chadron, 14 (UMMZ). SIOUX COUNTY: *Coffee Ranch, 21 mi. NW Crawford,* 2 (NSM); *badlands near Orella,* 12 (NSM); *Toadstool Park, near Orella,* 2 (NSM); 2 mi. S, 2 mi. W Orella, 1 (NSM); *5 mi. S Orella,* 1; *11 mi. N Harrison,* 2; *Warbonnet Canyon,* 9 (1 CM, 8 NSM); Warbonnet Twp., 8 mi. N Harrison, 1 (UMMZ); *Plunkett's Ranch, 10 mi. NE Harrison,* 2 (NSM); *6 mi. NW Harrison,* 3 (NSM); *Monroe Canyon,* 6 (2 AMNH, 3 NGFPC, 1 NSM); *West Monroe Canyon,* 3 (NSM); *Sowbelly Canyon,* 1 (NSM); *3½ mi. N, 1 mi. E Glen,* 7 (NSM); *Smily Canyon, Ft. Robinson,* 1 (NSM); Glen, 4 (1 AMNH, 3 NSM).

Additional records: DAWES COUNTY: Chadron (Gates, 1945:13); Belmont (Cary, MS).

Marmota monax

Woodchuck

The woodchuck, largest of Nebraskan sciurids, is restricted in distribution to the eastern part of the state. The species occurs largely in the Blue and Nemaha drainages but occurs also in the eastern part of the Platte drainage and north in the vicinity of the Missouri River at least as far as Dixon County. The woodchuck was first recorded from Nebraska by James (1823:369), who listed it among the mammals recorded at the Engineer Cantonment in what is now Washington County by Major Long's command in the winter of 1819-20.

According to Swenk (1938:350) who reviewed the status of *Marmota monax* in Nebraska, the species "was originally confined

. . . to the bottom lands of the Missouri River, from about the mouth of the Platte River southward, and was decidedly uncommon even there." He further contended that the woodchuck began to increase in numbers and to expand its range westward in the early part of the 20th Century. Possibly this was the case, although I have no information either to corroborate or to contradict his contention. Several reports (Swenk, *op. cit.*:351-353) after 1922 of woodchuck populations so high in certain areas as to create serious agricultural problems tend to support at least the thesis of increasing numbers.

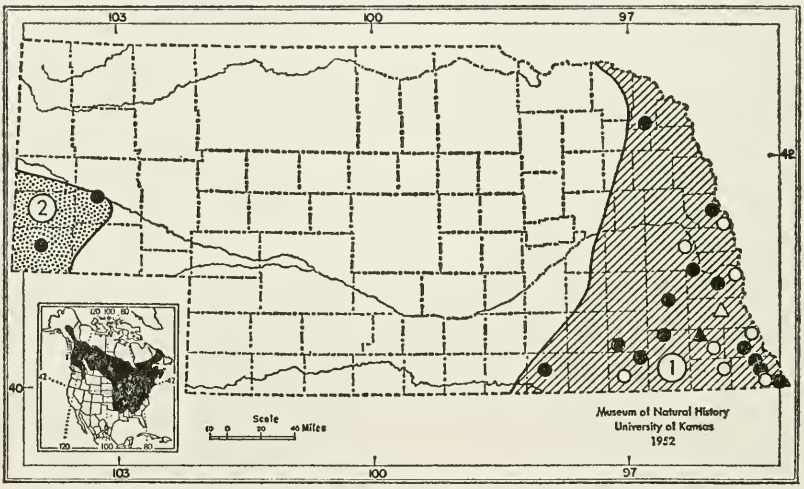

FIG. 23. Distribution of two species of sciurids in Nebraska. 1. *Marmota monax bunkeri*. 2. *Spermophilus richardsonii elegans*. For explanation of symbols see Fig. 5. Inset map shows distribution of *M. monax* in North America.

Possibly the planting of many hundred of miles of Osage orange hedgerows provided avenues of dispersal and sites for burrows for the woodchuck in many areas. Swenk (*loc. cit.*) cited several instances of *M. monax* inhabiting Osage orange hedges and it is in this habitat that I have most frequently seen the species. In the last decade, however, many farmers in southeastern Nebraska have destroyed these hedges (103 miles alone in Pawnee County in one year) because they sap ground water and nutritive elements from the soil of adjacent croplands. A noticeable reduction in numbers of *M. monax* in many places in the past 10 years or so may well be correlated with the destruction of Osage orange hedgerows.

The occurrence of the species in northeastern Nebraska long has been suspected. Paul Heil of Ponca reported to me (personal com-

munication) on July 9, 1952, that in the spring of that year he and his son caught and kept in captivity for several weeks what they believed to have been a young woodchuck. Findley (1956*b*:30) reported the possible occurrence of *M. monax* in Clay County, South Dakota, across the Missouri River from Dixon and Cedar counties. Scott (1937:68) recorded it from several places in northwestern Iowa and Polder (1958:562) mentioned its occurrence in all Iowan counties bordering the Missouri from Sioux City southward. Not until July 1, 1960, however, was a specimen taken on the Nebraska side when George Brog killed an individual of unknown sex 6 mi. NW Wakefield. The skull alone was saved and was communicated to me by George Schildman of the Nebraska Game, Forestation and Parks Commission. This specimen tentatively is referred to the subspecies *M. m. bunkeri;* woodchucks from northwestern Iowa have been assigned to *M. m. monax.*

No record of reproduction of this species in Nebraska is presently available. Grizzell (1955:269) reported an average of 4.6 young per litter in Maryland, the largest litter containing 8 young. The woodchuck is monestrous; the single litter is born in spring.

Marmota monax bunkeri Black

Marmota monax bunkeri Black, Jour. Mamm., 16:319, November 15, 1935 (type locality, 7 mi. SW Lawrence, Douglas Co., Kansas); Jones and Webb, Jour. Mamm., 30:313, August 17, 1949; Hall and Kelson, The mammals of North America, p. 321, March 31, 1959.

Arctomys monax, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823; Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Marmotta monax, Swenk, Proc. Nebraska Acad. Sci., 8:87, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:31, September, 1908.

Marmotta monax monax, Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920.

M[armota]. m[onax]. bunkeri, Swenk, Jour. Mamm., 19:349, August 18, 1938; Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Eastern part of state, principally south of Platte River in Blue and Nemaha drainages, west at least to Nuckolls County, north along Missouri River at least to Dixon County. See Fig. 23.

External measurements.—Average and extreme measurements of four males and four females from southeastern Nebraska are, respectively: 597.2 (579-654), 581.5 (543-624); 142.0 (125-155), 136.8 (124-142); 93.5 (93-94), 89.3 (86-97); 24 (one specimen), 31.0[2] (28-34). For cranial measurements see Table 8.

Two of the above-mentioned males weighed 7½ and 9 lbs.; one of the females weighed 6 lbs. Cockrum (1952:118) reported weights of woodchucks in Kansas of up to 9 lbs. 12 oz.

Records of occurrence.—Specimens examined, 15, as follows: CASS COUNTY: NE of Weeping Water, 1 (NSM); *no specific locality,* 1 (NSM). DIXON COUNTY: 6 mi. NW Wakefield, 1. GAGE COUNTY: near Cortland, 1 (UNDZ).

JEFFERSON COUNTY: Plymouth, 1 (NGFPC). JOHNSON COUNTY: no specific locality, 1 (NSM). LANCASTER COUNTY: Lincoln, 1 (UC); *8 mi. S Lincoln,* 1 (NSM). NEMAHA COUNTY: 7 mi. S Auburn, 1 (NSM). NUCKOLLS COUNTY: near Nelson, 1 (skin HM, skull KU). RICHARDSON COUNTY: Stella, 1 (NSM); 2 mi. W Verdon, 1 (NGFPC); Rulo, 1 (WSC). SALINE COUNTY: Western, 1 (NSM). SAUNDERS COUNTY: 1 mi. S, 2½ mi. E Ashland, 1 (NSM). WASHINGTON COUNTY: Blair, 1 (RV).

Additional records (Swenk, 1938:350-353, unless otherwise noted): CASS COUNTY: "a few" mi. S Plattsmouth. JEFFERSON COUNTY: near Fairbury. JOHNSON COUNTY: "neighborhood" Tecumseh; *"neighborhood" Elk Creek.* NEMAHA COUNTY: vicinity Peru; *3 mi. S, 2 mi. W Brownville; 2 mi. N, 5 mi. E Auburn.* OTOE COUNTY: no specific locality. PAWNEE COUNTY: ¼ mi. S Table Rock. RICHARDSON COUNTY: *2 mi. SW Salem;* 2 mi. S, 3 mi. W Falls City; *vicinity Rulo* (Jones and Webb, 1949:313). SAUNDERS COUNTY: near Mead; *near Ashland.* WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369).

TABLE 8.—CRANIAL MEASUREMENTS OF TAMIAS, EUTAMIAS, AND MARMOTA.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Condylobasal length	Zygomatic breadth	Postorbital constriction	Length of nasals	Length of maxillary tooth-row	Depth of skull
Tamias striatus griseus, Doniphan County, Kansas							
13701 KU, ♀	43.4	41.2	23.5	11.8	15.0	6.5	15.8
Eutamias minimus pallidus, Sioux County							
Average 10 (5♂, 5♀)	32.3	30.0	18.5	10.4	9.7	5.3	13.2
Minimum	30.8	28.8	17.7	10.0	9.2	5.0	12.7
Maximum	33.4	30.8	19.0	11.1	10.6	5.7	13.8
Marmota monax bunkeri, 8 mi. S Lincoln, Lancaster County							
2322 NSM, ♂	106.8	101.7	67.7	17.1	48.3	22.6	40.4
Johnson County							
3248 NSM, ♂	100.1	98.0	62.2	17.2	43.4	21.5	40.7
Stella, Richardson County							
4243 NSM, ♂	105.7	101.7	68.1	17.9	43.7	23.1	39.6
2 mi. W Verdon, Richardson County							
319 NGFPC, ♀*	91.2	89.1	60.9	19.8	40.3	20.5	36.8

* Young adult.

Spermophilus franklinii

Franklin's Ground Squirrel

In Nebraska, Franklin's ground squirrel is typically an inhabitant of the tall-grass prairie of the eastern part of the state. In recent years, however, the species seems to have extended its range westward along the river systems, probably in response to agricultural

practices, especially irrigation, in the river valleys. The westernmost record in Nebraska is of a specimen obtained in 1946 along the Platte River, 2 mi. NW Lisco, but the Elkhorn, Loup, Niobrara, and Republican rivers and their tributaries also have served as avenues of westward dispersal.

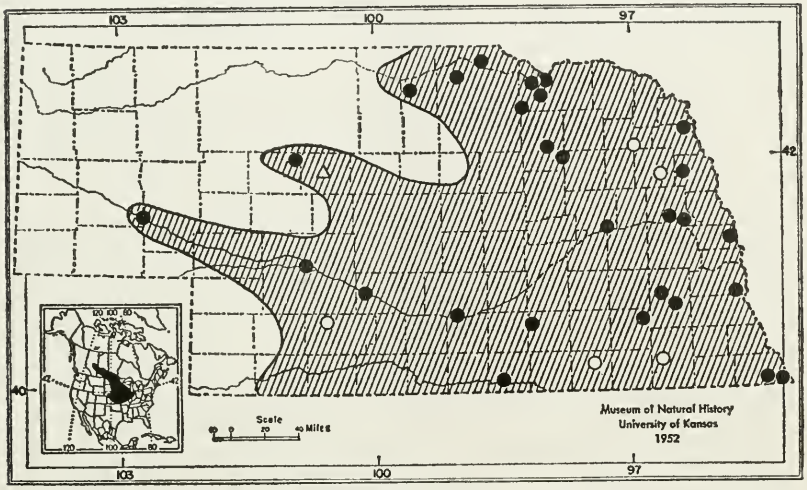

FIG. 24. Distribution of *Spermophilus franklinii* in Nebraska. For explanation of symbols see Fig. 5.

Swenk (1908:86) recorded the distribution of *S. franklinii* in the state as: "Very common in eastern Nebraska east of the 98th meridian, locally abundant, extending westward in the Platte valley to Buffalo County." Aughey (1880:120) reported the species as "common on the prairies." These remarks may signal a reduction in numbers of *S. franklinii* in eastern Nebraska in recent years; anyhow the species is now uncommon throughout the southeastern part of the state, and rare in some places. In my own experience, Franklin's ground squirrel was seen more frequently in the vicinity of Lincoln 15 years ago, even 10 years ago, than today. Possibly smaller populations result from destruction of favored habitat for burrow-sites for which the species evidently prefers tall grass, brush, or the wooded borders of grassy areas. Little is known, however, of the life history of this species and population fluctuations like those suggested by Sowls (1948:116) may be involved. Both the available records and my own observations suggest that *S. franklinii* may be more abundant today in northeastern Nebraska than in any other part of the state.

Females bear a single litter of 4-11 young (Sowls, 1948:119) in spring.

Spermophilus franklinii (Sabine)

Arctomys franklinii Sabine, Trans. Linn. Soc. London, 13:587, 1822 (type locality, Carlton House, Saskatchewan—see Preble, N. Amer. Fauna, 27:165-166, October 26, 1908).

Spermophilus Franklini, Lesson, Manuel de Mammalogie . . ., p. 244, 1827; Hayden, Trans. Amer. Philos. Soc., 12(n. s.): 145, 1863.

S[permophilus]. Franklini, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Spermophilus franklini, Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:709, 1859; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 93, 1875; J. A. Allen, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:881, August, 1877; V. Bailey, Bull. Div. Ornith. Mamm., U. S. D. A., 4:48, 1893.

Citellus franklini, Swenk, Proc. Nebraska Acad. Sci., 8:86, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:30, September, 1908; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920.

Citellus franklinii, Wade, Jour. Mamm., 11:164, May 9, 1930; A. H. Howell, N. Amer. Fauna, 56:133, May 18, 1938.

C[itellus]. franklinii, Wade, Jour. Mamm., 31:158, May 25, 1950.

Spermophilus franklinii, Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:483, April 21, 1954; Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957; Hall and Kelson, The mammals of North America, p. 351, March 31, 1959.

Distribution in Nebraska.—Eastern and central parts of state, west along river valleys certainly to Hooker, Morrill, and Rock counties. See Fig. 24.

External measurements.—Average and extreme measurements of six males from eastern Nebraska (Lancaster, Richardson, and Thurston counties) are: 395.5 (384-412); 139.0 (134-145); 56.6 (55-59); 16.0 (13-18). Measurements of a male and female from Kelso are, respectively: 395, 395; 136, 141; 58, 55; 15, 14. A male from 3 mi. S Rulo weighed 540 grams. For cranial measurements see Table 9.

Records of occurrence.—Specimens examined, 51, as follows: BOYD COUNTY: Spencer, 2 (1 NSM, 1 UNDZ). BUFFALO COUNTY: Kearney, 1 (USNM). BURT COUNTY: 3 mi. N Oakland, 1 (WFR). CASS COUNTY: Union, 1 (RV). CLAY COUNTY: Inland, 3 (HM). DAWSON COUNTY: E of Gothenburg, 1 (NSM). DODGE COUNTY: Ames, 1 (USNM); Fremont, 1 (RV). DOUGLAS COUNTY: Omaha, 1 (RV). HOLT COUNTY: 10 mi. NE Stuart, 2 (NSM). HOOKER COUNTY: Kelso, 8 (UMMZ). KNOX COUNTY: Niobrara, 1 (USNM); 8 mi. SW Niobrara, 1 (NGFPC); Verdigre, 1 (USNM); Venus, 1 (RV). LANCASTER COUNTY: 4 mi. NW Lincoln, 1 (NGFPC); *Capitol Beach, W of Lincoln,* 1 (USNM); *Lincoln,* 8 (1 MVZ, 2 NGFPC, 2 NSM, 3 UNDZ); 2 mi. E Cheney, 1 (NSM). LINCOLN COUNTY: North Platte, 2 (UNDZ). MADISON COUNTY: Tilden, 1 (NSM). MORRILL COUNTY: 2 mi. NW Lisco, 1 (NSM). PLATTE COUNTY: Columbus, 2 (USNM). RICHARDSON COUNTY: Falls City, 1; 3 mi. S Rulo, 1. ROCK COUNTY: near Bassett, 1 (RV). SALINE COUNTY: Crete, 1 (Stanford Univ.). THURSTON COUNTY: 1 mi. S Winnebago, 1. WEBSTER COUNTY: Red Cloud, 1 (NSM).

Additional records: CUMING COUNTY: West Point (Swenk, 1908:86). GAGE COUNTY: Beatrice (Swenk, 1908:86). FRONTIER COUNTY: Curtis (Swenk, MS). PLATTE COUNTY: *"near the mouth of the Loup Fork of the Platte"* (Hayden, 1859:709). THAYER COUNTY: Belvidere (Swenk, 1908:86). THOMAS COUNTY: no specific locality ("along rivers") (Smith, 1958:59). WAYNE COUNTY: 9 mi. S Wayne (Jones, field notes).

Spermophilus richardsonii

Richardson's Ground Squirrel

Richardson's ground squirrel is known in Nebraska only from the southern part of the Panhandle where the species evidently is rare. According to A. H. Howell (1938:10) it "inhabits the sage and greasewood plains, chiefly in the Transition Zone and partly in the Upper Sonoran." The species is common at many places in north-central Colorado and in southeastern Wyoming.

Two specimens are known from Nebraska. One of these was obtained by the late A. M. Brooking on September 20, 1915, from a "small colony" at Kimball and was displayed for many years in the Hastings Museum (HM 2337). I examined the specimen there in 1949 but it has since been discarded. The other specimen is a partial skull having complete dentition from Bridgeport (NSM 1210). Probably S. *richardsonii* is, or at least was, sparingly distributed in Banner and Kimball counties, western Cheyenne County, and southwestern Morrill County south of the Platte River, although the area in question certainly constituted marginal habitat for the species. One resident of western Banner County, a government predator control agent, reported to me in 1946 that he was familiar with a large, grayish ground squirrel in that area, which he readily distinguished from S. *tridecemlineatus,* and which almost certainly was S. *richardsonii.* I do not now remember, however, whether he was recalling past experience or speaking of the present.

I have collected mammals on several occasions in the southwestern part of the Panhandle and have never seen Richardson's ground squirrel there. Similarly, Burnett (1920:5) reported that "none were seen on a scouting trip to western Nebraska made in June, 1920. The first squirrel seen on this trip after leaving Nebraska and entering Wyoming, was about twenty miles west of the Wyoming-Nebraska line." I wonder whether the concentrated "rodent control" programs of the early 1900's annihilated this squirrel in Nebraska or so reduced numbers that it did not long survive. One of the most likely places where the species might yet be found is on the slopes of the Bighorn and Wildcat ridges in Banner County.

Females give birth to a single litter in spring. Forty-four females from Colorado, collected in the years 1916, 1920, and 1923, carried an average of 6.6 (1-11) embryos (Burnett, 1931:14).

Spermophilus richardsonii elegans Kennicott

Spermophilus elegans Kennicott, Proc. Acad. Nat. Sci. Philadelphia, 15:158, "June" (received at Smithsonian Institution, October 27), 1863 (type locality, Fort Bridger, Uinta Co., Wyoming).

Spermophilus r[ichardsoni]. elegans, V. Bailey, Bull. Div. Ornith. Mamm., U. S. D. A., 4:60, 1893.

Distribution in Nebraska.—Known only from Kimball and Morrill counties, limits of distribution in state unknown; if still extant in Nebraska probably restricted to extreme southwestern part of Panhandle. See Fig. 23.

External measurements.—No measurements of Nebraska-taken *S. r. elegans* are available. Average and extreme measurements of six females from Laramie County, Wyoming, are: 282.5 (270-295); 76.8 (70-85); 43.7 (41-46); 15.2 (12-19). The average weight in grams of five of the above-mentioned females was 265.5 (218-313). For cranial measurements see Table 9.

Records of occurrence.—Specimens examined, 2, as follows: KIMBALL COUNTY: Kimball, 1 (HM). MORRILL COUNTY: Bridgeport, 1 (NSM).

Spermophilus spilosoma

Spotted Ground Squirrel

Spermophilus spilosoma is a characteristic mammal of the Sand Hills where the species is not uncommon, although nowhere so numerous as the thirteen-lined ground squirrel. The spotted ground squirrel occurs also on the High Plains to the west and southwest of the Sand Hills. Throughout its range in Nebraska it is sympatric with *S. tridecemlineatus* and, while the two species frequently are found at the same places, *spilosoma* tends to seek drier habitats than

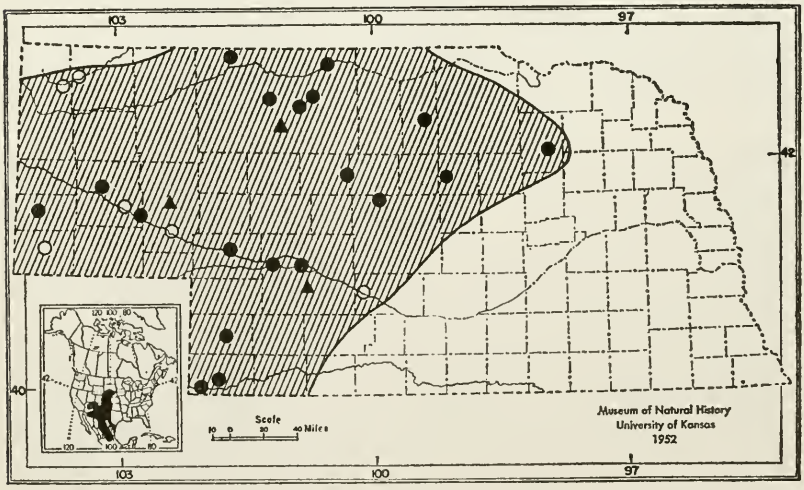

FIG. 25. Distribution of *Spermophilus spilosoma obsoletus* in Nebraska. For explanation of symbols see Fig. 5.

tridecemlineatus and is more likely to be found in sandy areas. On the High Plains I have found this ground squirrel on sage-covered hills and along the roadside borders of upland wheat fields. Like other Nebraskan spermophiles, *S. spilosoma* is diurnal, and like the other species hibernates in the colder part of the year and may aestivate in summer.

Each of two females collected at Valentine on June 20, 1888, by Vernon Bailey contained eight embryos. Females may bear two litters annually in the southern part of the range of the species; possibly they do so in Nebraska.

Spermophilus spilosoma obsoletus Kennicott

Spermophilus obsoletus Kennicott, Proc. Acad. Nat. Sci. Philadelphia, 15: 157, "June" (received at Smithsonian Institution October 27), 1863 (type locality restricted to 50 mi. W Ft. Kearney [= vicinity Gothenburg], Dawson Co., Nebraska, by A. H. Howell, N. Amer. Fauna, 56: 131, May 18, 1938); J. A. Allen, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:866, August, 1877; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:254, November, 1896.

Spermophilus spilosoma obsoletus, V. Bailey, Bull. Div. Ornith. Mamm., U. S. D. A., 4:58, 1893; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Hall and Kelson, The mammals of North America, p. 350, March 31, 1959.

Citellus obsoletus, Swenk, Proc. Nebraska Acad. Sci., 8:85, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:29, September, 1908 (part); Lyon and Osgood, Bull. U. S. Nat. Mus., 62:168, January 28, 1909; Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Wade, Jour. Mamm., 11:164, May 9, 1930; G. M. Allen, Bull. Mus. Comp. Zool., 71:252, January, 1931.

Citellus spilosoma major, Swenk, Proc. Nebraska Acad. Sci., 8:85, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:29, September, 1908 (part).

Citellus spilosoma obsoletus, A. H. Howell, N. Amer. Fauna, 56:130, May 18, 1938; Poole and Schantz, Bull. U. S. Nat. Mus., 178:516, April 9, 1942; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:203, March 3, 1955.

S[permophilus]. s[pilosoma]. obsoletus, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Western two-thirds of state, excepting extreme northwestern part, east certainly to Antelope County. See Fig. 25.

External measurements.—Average and extreme measurements of seven specimens (two males, five females) from Cherry County are: 216.6 (201-226); 64.3 (61-69); 31.4 (30-33). Measurements of one female each from Custer, Dundy, and Morrill counties are, respectively: 235, 225, 242; 70, 66, 64; 33, 32, 31; 8.5, 12, 10. For cranial measurements see Table 9.

A male from 1 mi. S Imperial weighed 194.5 grams and a female from 3 mi. NW Lisco weighed 152.5 grams.

Remarks.—The spotted ground squirrel is sympatric throughout its range in Nebraska with *Spermophilus tridecemlineatus,* from which species *S. s. obsoletus* is easily distinguished externally by its

brownish dorsum. Cranially the two species are less distinct but *obsoletus* has a broader rostrum, interorbital region and postorbital region, more inflated braincase, shorter nasals, and distinctly larger auditory bullae. Important differences between the bacula of the two species also have been found (Wade and Gilbert, 1940:54-56).

Some confusion exists in the literature concerning the exact origin of three specimens collected in August of 1857 along the North Platte River by J. G. Cooper. J. A. Allen (*in* Coues and Allen, 1877:868) listed all three specimens (USNM 3223-25) as collected on August 17 at a place 230 mi. W Ft. Kearney. According to Lyon and Osgood (1909:169), however, no. 3223 was obtained on August 16, 120 mi. W Ft. Kearney, whereas nos. 3224-25 were taken on the following day 130 mi. W Ft. Kearney. G. M. Allen (1931:252) listed no. 3223 as from 220 mi. W Ft. Kearney on August 16. I have examined USNM 3224-25 and what I judge to be the original label of each lists the locality as 230 mi. W Ft. Kearney and the date as August 17, 1857, which I accept as correct. I have not seen no. 3223 (now MCZ 4819) but assuming the correct date of capture to be August 16, the locality designation of 220 mi. W Ft. Kearney is reasonable. Both localities fall in present-day Morrill County. Cooper also collected the lectotype of *S. s. obsoletus* on August 9, 1857, 50 mi. W Ft. Kearney.

Records of occurrence.—Specimens examined, 37, as follows: Antelope County: Neligh, 1 (USNM). Banner County: Harrisburg, 1. Chase County: 1 mi. S Imperial, 1. Cherry County: Merriman, 1 (NSM); Valentine, 4 (USNM); Snake River [25 mi. S Cody according to Cary, MS], 1 (USNM); Simeon, 1 (USNM); Kennedy, 6 (USNM); no specific locality, 1 (USNM). Custer County: 1 mi. NW Gavin, 1 (UMMZ). Dundy County: 5 mi. N, 2 mi. W Parks, 1; Haigler, 1 (NSM). Garden County: no specific locality, 1. Garfield County: 10 mi. N Burwell, 1 (UNM). Keith County: 2 mi. N Kingsley Dam (New Market Station), 1 (NGFPC). Lincoln County: Sutherland, 1; *O'Fallons Bluff*, 1 (USNM); North Platte, 5 (3 UNDZ, 2 USNM); no specific locality, 1 (USNM). Morrill County: 5 mi. N Bridgeport, 1 (MVZ); *230 mi. W Ft. Kearney* [= *vicinity Bridgeport,*] 2 (USNM); 3 mi. NW Lisco, 1. Rock County: Perch, 1 (AMNH). Thomas County: Halsey, 1 (UNDZ).

Additional records: Dawes County: Crawford (Swenk, 1908:84); *Ft. Robinson* (Swenk, 1908:84). Dawson County: 50 mi. W Ft. Kearney [= vicinity Gothenburg] (A. H. Howell, 1938:131). Garden County: Oshkosh (Swenk, MS). Kimball County: near Kimball (Swenk, MS). Morrill County: 220 mi. W Ft. Kearney [= vicinity Broadwater] (G. M. Allen, 1931: 252). Sioux County: near Glen (Swenk, 1908:84).

Spermophilus tridecemlineatus

Thirteen-lined Ground Squirrel

The thirteen-lined ground squirrel is state-wide in distribution and is the most abundant sciurid in Nebraska. The species seems

to prefer areas of short grass such as heavily grazed pastures, golf courses, and the mowed borders of highways. Occasionally *S. tridecemlineatus* becomes so numerous locally that it is detrimental to certain agricultural crops. The species hibernates in Nebraska from September or early October until about mid-March.

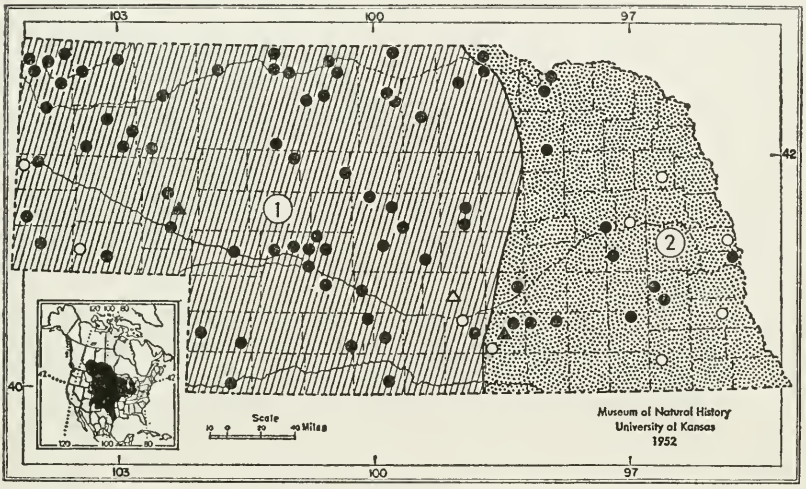

FIG. 26. Distribution of *Spermophilus tridecemlineatus* in Nebraska. 1. *S. t. pallidus*. 2. *S. t. tridecemlineatus*. For explanation of symbols see Fig. 5.

Adults of *S. tridecemlineatus* (and of other Nebraskan ground squirrels) are leanest upon emergence from hibernation in spring. Frequently they gain relatively little weight in late spring and early summer. Fat deposition in preparation for hibernation usually begins in the latter part of July or in early August, and at that time individuals may gain 30 grams or more per week (Wade, 1948). Proportionate increases in weight have been observed also for *S. spilosoma* and for *S. franklinii*. Animals that aestivate lose considerable weight during that period. According to Wade (1927*a*:274), the weight in summer of "most adult males" of *S. tridecemlineatus* is between 160 and 180 grams.

Females bear a single litter annually in spring. Six females from Nebraska taken in April and May carried an average of 9.3 (6-12) embryos. Lactating females have been collected in June.

One albino (HM 22047), obtained in Adams County on July 23, 1942, was among the 272 specimens examined of *S. tridecemlineatus*. On this specimen the dorsal stripes are barely visible, being a purer white than other parts of the dorsum.

Spermophilus tridecemlineatus pallidus J. A. Allen

Spermophilus tridecem-lineatus var. *pallidus* J. A. Allen, Proc. Boston Soc. Nat. Hist., 16:291, June, 1874 (*nomen nudum*).

Spermophilus tridecemlineatus var. *pallidus* J. A. Allen, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:872, August, 1877 (type locality restricted to mouth of the Yellowstone River, McKenzie Co., North Dakota, by A. H. Howell, N. Amer. Fauna, 56:122, footnote, May 18, 1938).

Spermophilus tridecem-lineatus, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):42, July 14, 1858.

S[permophilus]. tridecemlineatus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880 (part).

Spermophilus tridecemlineatus, V. Bailey, Bull. Div. Ornith. Mamm., U. S. D. A., 4:31, 1893 (part).

Spermophilus tridecemlineatus pallidus, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:254, November, 1896; Hall and Kelson, The mammals of North America, p. 347, March 31, 1959.

Spermophilus 13-lineatus pallidus, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Citellus tridecemlineatus pallidus, Swenk, Proc. Nebraska Acad. Sci., 8:86, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:30, September, 1908; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; A. H. Howell, N. Amer. Fauna, 56:112, May 18, 1938 (part).

[Citellus tridecemlineatus] pallidus, Wade, Jour. Mamm., 11:164, May 9, 1930.

Citellus tridecimlineatus [sic] pallidus, G. M. Allen, Bull. Mus. Comp. Zool., 71:254, January, 1931.

Citellus tridecemlineatus tridecemlineatus, Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; A. H. Howell, N. Amer. Fauna, 56:107, May 18, 1938 (part).

Citellus t[ridecemlineatus]. pallidus, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

S[permophilus]. t[ridecemlineatus]. pallidus, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957 (part).

S[permophilus]. t[ridecemlineatus]. arenicola, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957 (part).

Distribution in Nebraska.—Western two-thirds of state, east certainly to Holt, Kearney, and Valley counties. See Fig. 26.

External measurements.—Average and extreme measurements of 18 specimens (14 males, four females) from Cherry County are: 245.2 (230-267); 84.8 (78-91); 34.2 (32-36); 8 (one specimen). A female from Chase County weighed 191.3 grams. For cranial measurements see Table 9.

Remarks.—For comparison with *Spermophilus tridecemlineatus tridecemlineatus* of eastern Nebraska, see account of that subspecies.

Among the specimens herein assigned to *pallidus*, the six from Valley County and the single specimen from 10 mi. NE Stuart are darker than typical specimens and are intergrades with *S. t. tridecemlineatus*. In general, individuals taken on the Sand Hills are slightly paler than those from other localities.

A. H. Howell (1938), in his revision of North American ground squirrels, allocated individual specimens to subspecies without regard for the average of characters in a series from one locality. Frequently therefore individuals from the same place were assigned to different subspecies and, by consequence, some of Howell's assignments bear little relationship to his map (fig. 9, p. 108) of the distribution of the subspecies of S. *tridecemlineatus*. Individuals referred by Howell (p. 109) to S. *t. tridecemlineatus* from Broken Bow, Glen, and North Platte are here listed under S. *t. pallidus*.

Several years ago (1957:275) I listed S. *t. arenicola* as occurring in southwestern Nebraska on the basis of a dull-colored specimen from Frontier County, but subsequent examination of other specimens from southwestern Nebraska, along with the holotype of *arenicola*, convinced me that all specimens from western Nebraska are best assigned to S. *t. pallidus*. The differences between *arenicola* and *pallidus* are slight and clinal in nature; the area of intergradation between the two is broad and encompasses, according to some authors, the type locality of *arenicola*. S. *t. arenicola* represents the population of the species on the southern Great Plains and S. *t. pallidus* represents the population on the central Great Plains. Possibly the recognition of two subspecies on the Great Plains, based on slight differences in color and size, is unwarranted.

J. A. Allen did not designate a type specimen or type locality in the original description of *pallidus*. Later (1895*b*:338), he designated the "plains of the lower Yellowstone River" as the "type region." Howell (1938:112) further restricted the type locality to the mouth of the Yellowstone River, Montana, naming USNM 16237 (a specimen originally listed by Allen) as lectotype. The selection of this locality by Howell was unfortunate because it lies in an area of intergradation between *pallidus* and S. *t. tridecemlineatus*. Howell, for example, assigned all specimens available to him from the north bank of the Missouri opposite the mouth of the Yellowstone to the latter subspecies.

A specimen (USNM 17220) from near the head of the Blue River was listed by Howell (*op. cit.*:114) as from Hamilton County. Probably this specimen is from along the Little Blue River, on the well-used wagon trail from Ft. Riley to Ft. Kearney; the Little Blue has its source in Kearney County. Both Howell (*loc. cit.*) and J. A. Allen (*in* Coues and Allen, 1877:880) listed a specimen (USNM 3779) from 137 mi. W Ft. Kearney as from "O'Fallons Bluff." Actually this specimen originated in what is now Keith County, near the present hamlet of Keystone.

Records of occurrence.—Specimens examined, 170, as follows: BANNER COUNTY: SW of Flowerfield, 1 (NGFPC). BOX BUTTE COUNTY: Hemingford, 6 (NSM); *near Hemingford,* 2 (NSM); Box Butte, 12½ mi. N, 5½ mi. E Alliance, 2(UMMZ); Alliance, 1 (USNM); 20 mi. N Bayard, 1 (NSM). BROWN COUNTY: 4 mi. N Ainsworth, 1 (CNHM); Long Pine, 1 (Stanford Univ.). CHASE COUNTY: 10 mi. W Imperial, 3; *3 mi. NW Wauneta,* 2; 2 mi. NW Wauneta, 1. CHERRY COUNTY: Cody, 1 (USNM); Valentine, 23 (1 NSM, 1 UMMZ, 21 USNM); *4 mi. E Valentine,* 3; *Ft. Niobrara Nat'l Wildlife Refuge,* 6 (NSM); *S of Valentine,* 1 (NGFPC); Niobrara River, 10 mi. S Cody, 1 (NSM); 18 mi. NW Kennedy, 1 (USNM); 12 mi. ESE Gordon, 1 (CNHM); *Niobrara River,* 1 (USNM); 7 mi. S, 6 mi. E Valentine, 1 (CNHM); 5 mi. N Hackberry Lake, 1 (UMMZ); *Hackberry Lake,* 2 (UMMZ); *2 mi. W Kennedy,* 1; Kennedy, 10 (USNM); *11 mi. E Kennedy,* 1; North Fork, Middle Loup River, NW of Mullen, 1 (NSM); *no specific locality,* 1 (NSM). CHEYENNE COUNTY: *3 mi. N Sidney, 4300 ft.,* 1; Sydney, 1 (USNM). CUSTER COUNTY: 4 mi. NW Gavin, 1 (UMMZ); ¼ mi. NE Victoria Springs, 3 (UMMZ); near Broken Bow, 1 (UNDZ); Callaway, 1 (USNM); 6 mi. SW Mason City, 1 (UMMZ). DAWES COUNTY: Chadron, 1 (CSTC); Crawford, 2 (1 HM, 1 NSM). DAWSON COUNTY: Gothenburg, 6 (5 NSM, 1 USNM); *3 mi. ESE Gothenburg,* 3. DUNDY COUNTY: Benkelman, 1 (NGFPC). FRONTIER COUNTY: Eustis, 1 (USNM); 15 mi. SE Stockville, 1 (NSM). FURNAS COUNTY: Beaver City, 1 (USNM). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge, 1 (USNM); Oshkosh, 3 (NSM); no specific locality, 2. GOSPER COUNTY: Homerville, 1 (USNM). HOLT COUNTY: 6 mi. N Midway, 1; 10 mi. NE Stuart, 1 (NSM). HOOKER COUNTY: Kelso, 2 (UMMZ). ?KEARNEY COUNTY: head of [?Little] Blue River, 1 (USNM). KEITH COUNTY: 137 mi. W Ft. Kearney, 1 (USNM). KEYA PAHA COUNTY: 12 mi. N Springview, 2; *12 mi. NNW Springview,* 1. KIMBALL COUNTY: S of Kimball, 2 (NGFPC); *no specific locality,* 4 (UNDZ). LINCOLN COUNTY: Myrtle, 1 (USNM); 15 mi. NE North Platte, 1 (USNM); 15 mi. NW North Platte, 1 (USNM); 10 mi. N North Platte, 1 (USNM); *6 mi. N North Platte,* 1 (USNM); Birdwood Creek, 1 (USNM); North Platte, 3 (UNDZ); *3 mi. SE North Platte,* 1 (USNM); 15 mi. SE North Platte, 1 (USNM). ROCK COUNTY: Perch, 1 (AMNH). SHERIDAN COUNTY: Niobrara River, 1 (USNM); 4 mi. N Antioch, 2 (UMMZ). SIOUX COUNTY: Orella, 2 (NSM); Warbonnet Canyon, 1 (NSM); *head of Warbonnet Creek,* 1 (CM); 10 mi. NE Harrison, 2 (NSM); *4 mi. N, 1½ mi. W Harrison,* 1 (NGFPC); Harrison, 1 (CM); *2 mi. SE Harrison,* 1 (NGFPC); *10 mi. W Crawford,* 5 (NSM); *5½ mi. W Crawford,* 1 (NSM); Glen, 1 (NSM); 4 mi. E Agate, 2. SCOTTS BLUFF COUNTY: Mitchell, 1 (NSM). THOMAS COUNTY: Halsey, 4 (AMNH). VALLEY COUNTY: Ord, 3; 10 mi. S Ord, 3 (NGFPC). County unknown: *Platte River, 320 mi. from Ft. Riley,* 1 (USNM); *Platte River, "48 M. K.,"* 1 (USNM).

Additional records: BUFFALO COUNTY: no specific locality (V. Bailey, 1893:37). CHEYENNE COUNTY: "Pole Creek" [specimen obtained on July 25, 1856, on Lodgepole Creek in western part of county by W. S. Wood] (Baird, 1858:318). CUSTER COUNTY: *10 mi. S Ansley* (Cahalane, 1954:419). KEARNEY COUNTY: Ft. Kearney (Baird, 1858:317). LINCOLN COUNTY: *forks of the Platte River* (G. M. Allen, 1931:253). SCOTTS BLUFF COUNTY: 30 mi. E [Ft.] Laramie [Wyoming] (J. A. Allen, *in* Coues and Allen, 1877:880). County unknown: *Loup Fork* (J. A. Allen, *in* Coues and Allen, 1877:880); *Sand Hills near Platte [River]* (Baird, 1858:318); *Platte River* (J. A. Allen, *in* Coues and Allen, 1877:880).

Spermophilus tridecemlineatus tridecemlineatus (Mitchill)

Sciurus tridecem-lineatus Mitchill, Med. Repos. (n. s.), 6(21):248, 1821 (type locality, "region bordering the sources of the river Mississippi;" restricted to central Minnesota by J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:338, November 8, 1895).

Spermophilus tridecem lineatus, Audubon and Bachmann, The viviparous quadrupeds of North America, 1:294, 1849.

S[permophilus]. tridecemlineatus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880 (part).

Spermophilus tridecemlineatus, V. Bailey, Bull. Div. Ornith. Mamm., U. S. D. A., 4:31, 1893 (part).

Citellus tridecemlineatus, Swenk, Proc. Nebraska Acad. Sci., 8:85, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:29, September, 1908; Wade, Jour. Mamm., 8:275, November 11, 1927; Wade, Jour. Mamm., 11:164, May 9, 1930; Wade, Jour. Mamm., 31:158, May 25, 1950.

Citellus tridecemlineatus tridecemlineatus, Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Whelan, Trans. Kansas Acad. Sci., 39:365, 1937; A. H. Howell, N. Amer. Fauna, 56:107, May 18, 1938 (part).

Citellus tridecemlineatus pallidus, A. H. Howell, N. Amer. Fauna, 56:112, May 18, 1938 (part).

S[permophilus]. t[ridecemlineatus]. tridecemlineatus, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Spermophilus tridecemlineatus tridecemlineatus, Hall and Kelson, The mammals of North America, p. 347, March 31, 1959.

Distribution in Nebraska.—Eastern third of state, west certainly to Adams, Antelope, Boyd, and Hall counties. See Fig. 26.

External measurements.—Average and extreme measurements of nine specimens (two males, seven females) from southeastern Nebraska (Butler, Lancaster, and Saline counties) are: 269.3 (261-287); 94.8 (87-103); 35.5 (34-38); 10.8 (9-13). For cranial measurements see Table 9.

Eight lactating females (June-taken) from Shawnee County, Kansas, weighed an average of 146.2 (126.7-165.8) grams; a male from the same place weighed 190.0 grams.

Remarks. — From *Spermophilus tridecemlineatus pallidus,* geographically adjacent to the west in Nebraska, *S. t. tridecemlineatus* differs in: size larger externally; dorsum conspicuously darker; sides, dorsal aspect of feet, and venter darker, being yellowish orange rather than pale yellowish white. *S. t. tridecemlineatus* averages only slightly larger than *S. t. pallidus* in cranial dimensions.

Specimens from the western edge of the range of *S. t. tridecemlineatus* (Adams, Antelope, Boyd, Clay, and Hall counties) are intergrades with *S. t. pallidus,* but in size and coloration nearer *tridecemlineatus.* The specimen from Grand Island was assigned to *pallidus* by A. H. Howell (1938:114).

Records of occurrence.—Specimens examined, 102, as follows: ADAMS COUNTY: Hastings, 2 (RV); no specific locality, 3 (HM). ANTELOPE COUNTY: Neligh, 3 (NSM). BOYD COUNTY: Spencer, 1 (UNDZ); *4 mi. N Bristow,* 1. BUTLER COUNTY: Rising City, 3 (RV); *4 mi. E Rising City,* 15. CLAY COUNTY: Saronville, 2 (UF); Inland, 1 (HM). HALL COUNTY: Grand Island, 1 (UMMZ). KNOX COUNTY: 1½ mi. SE Niobrara, 2 (NGFPC); Verdigre, 1 (USNM). LANCASTER COUNTY: Malcolm, 1 (NSM); *4 mi. W Lincoln,* 2 (NSM); *3 mi. W Lincoln,* 1 (UNDZ); *1 mi. W Lincoln,* 1 (UC); Lincoln, 52 (1 AMNH, 10 NSM, 5 UC, 31 UNDZ, 1 USNM). PLATTE COUNTY: Columbus, 4 (USNM). SALINE COUNTY: 2 mi. E Dorchester, 1. SARPY COUNTY: Ft. Crook, 5 (AMNH).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). COLFAX COUNTY: Schuyler (specimen catalogued in Cleveland Museum of Natural History, not now to be found). CUMING COUNTY: West Point (Swenk, 1908: 85). DOUGLAS COUNTY: Omaha (Swenk, 1908:85). GAGE COUNTY: Beatrice (Swenk, 1908:85). LANCASTER COUNTY: *9 mi. NW Lincoln* (Whelan, 1937: 365); *no specific locality* (Rapp and Gates, 1957:53). OTOE COUNTY: Turlington (V. Bailey, 1893:37).

TABLE 9.—CRANIAL MEASUREMENTS OF FOUR SPECIES OF SPERMOPHILUS.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Condylobasal length	Zygomatic breadth	Postorbital constriction	Length of nasals	Length of maxillary tooth-row	Depth of skull
Spermophilus franklinii, Spencer, Boyd County							
4290 NSM, ♀	53.3	50.8	30.2	12.1	18.5	10.8	20.1
Verdigre, Knox County							
126399 USNM, ♂	54.9	51.9	30.8	13.0	19.5	11.2	20.7
4 mi. NW Lincoln, Lancaster County							
351 NGFPC, ♂	56.5	53.1	30.9	13.4	19.3	11.5	21.2
Spermophilus richardsonii elegans, Laramie County, Wyoming							
14876 KU, ♀	45.2	43.3	29.3	11.0	15.9	10.6	19.2
14877 KU, ♀	46.2	45.0	30.3	10.5	16.3	10.6	19.9
Spermophilus spilosoma obsoletus, Cherry County							
Average 10 (6♂, 4♀)	39.2	36.0	23.1	13.2	13.1	7.5	17.3
Minimum	38.0	34.9	22.3	12.2	12.2	7.1	16.9
Maximum	40.2	37.1	23.8	13.6	13.7	7.8	17.8
Spermophilus tridecemlineatus pallidus, Valentine, Cherry County							
Average 9 (6♂, 3♀)	39.5	37.0	23.7	10.8	14.4	7.5	16.9[8]
Minimum	37.2	35.0	22.2	10.0	13.4	7.4	15.5
Maximum	40.9	38.9	24.7	11.8	15.4	7.7	17.3
Spermophilus tridecemlineatus tridecemlineatus, Butler and Lancaster counties							
Average 6 (1♂, 5♀)	40.6	38.5	24.3	11.1	14.6	7.5	17.3
Minimum	39.3	37.0	23.5	10.3	13.8	7.1	17.0
Maximum	41.7	39.7	24.7	11.7	15.5	7.8	17.8

Cynomys ludovicianus

Black-tailed Prairie Dog

The black-tailed prairie dog is characteristically an inhabitant of the short-grass plains. In Nebraska the species occurred formerly nearly to the Missouri River, where continuous stands of tall-grass prairie, and possibly also the deciduous riparian association of the Missouri and its major tributaries, evidently served as an effective barrier to eastward dispersal. Presently, a few colonies, or "towns,"

of prairie dogs are found as far east as the 98th meridian in Nebraska but these are mostly isolated and the species can be described as common only in the western half of the state. Swenk (1915*a*:5-6) wrote of the easternmost records of occurrence in Nebraska as follows: "Up to about 1900 there used to be an 80-acre colony as far east as Plum Creek, near Beemer, in Cuming County, and another about one-half as large on Clark Creek, near Fontanelle, in Washington County, but these are now extirpated. As recently as 1902 the prairie dog extended east along the Niobrara River to the point of its junction with the Missouri."

Several authors have suggested that in the late 1800's and early 1900's the prairie dog not only increased in abundance but that it occupied previously uninhabited areas. Merriam (1901:263)

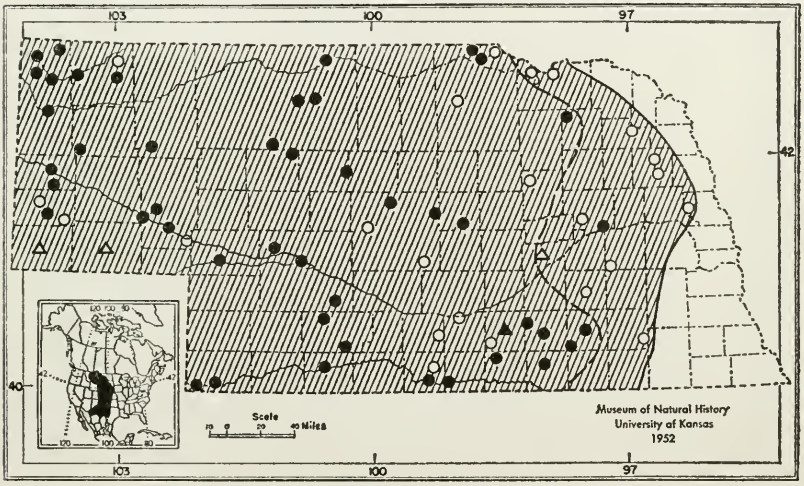

FIG. 27. Distribution of *Cynomys ludovicianus ludovicianus* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate eastern limit of present distribution.

thought this was "due to the coming of the white man, whose presence favors their multiplication in two ways—(1) by increasing the food supply [through cultivation], and (2) by decreasing the animal's natural enemies." Recently, however, R. E. Smith (1958) and Koford (1958) have pointed out that heavy grazing or overgrazing of western range lands was the principal reason for the spread of the species.

Prior to the coming of white man to Nebraska heavy grazing by the vast herds of bison and prairie fires probably helped to provide suitable habitat for the prairie dog. Indications of the former

abundance of species can be found in the historical literature. For example, James (1823:451), who accompanied Major Long across Nebraska in 1820, wrote of the species: "The country which we passed on the 14th [June, 1820], lying between the Loup fork and the Platte [in what is now Merrick County], has a moderately hilly surface, except that portion of it which comprises the bottom lands of the two rivers. The ridges are of little elevation, destitute of stone of any kind, and irregular in direction; the soil is sandy and infertile. The high and barren parts of this tract are occupied by numerous communities of the Prairie dog or Louisiana marmot." A little farther to the west, James (*op. cit.*:455) noted that the party "passed a number of prairie dog villages, some of them extending from two to three miles along the [Platte] river."

Although numbers of the prairie dog have been drastically reduced in the past several decades in Nebraska by poisoning and other control methods, the existence of the species does not appear to be threatened at the moment. This is owing partly to the increasing number of landowners who appreciate the asthetic value of this remarkable rodent and now recognize that damaging populations of the species result in large measure from land depletion through overgrazing. Some landowners actually protect colonies on their holdings, while at the same time they exercise control as needed on the size of the colonies so as not to allow them to become too large. This kind of "local" control is to be encouraged, because control—and by control I do not mean extermination but rather regulation of numbers—of native animals of any kind is usually a local problem and best solved by those directly involved.

Females bear young once annually in early spring; 2-10 embryos per female have been reported (Koford, 1958:19). Yearling females produce fewer young on the average than older animals or do not breed at all. Swenk (1915*a*:10) reported a female at Haigler on May 14 with "six quarter grown young."

Cynomys ludovicianus ludovicianus (Ord)

Arctomys Ludoviciana Ord, *in* Guthrie, A new geographical, historical, and commercial grammar . . ., ed. 2, 2:292 (description on p. 302), 1815 (type locality here restricted to lower slope of the "Tower," a prominent landmark in sec. 10, T. 34 N, R. 10 W, Boyd Co., Nebraska).

Cynomys ludovicianus, Baird, Mammals, *in* Reports of explorations and surveys from the Mississippi River to the Pacific Ocean . . ., 8(1):331, July 14, 1858; Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:709, 1859; J. A. Allen, Proc. Boston Soc. Nat. Hist., 13:190, February, 1870; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 93, 1875; J. A. Allen, *in* Coues and

Allen, Bull. U. S. Geol. Surv. Territories, 11:892, August, 1877; Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:87, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:31, September, 1908; Swenk, Bull. Nebraska Agric. Exp. Sta., 28(2):8, August 15, 1915; Swenk, Nebraska Blue Book, p. 852, 1915; Jones, Bull. Univ. Nebraska State Mus., 4:90, November 26, 1962.

Arctomys Ludoviciana, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:451, 1823.

Cynomys Ludovicianus, Hayden, Trans. Amer. Philos. Soc., 12(n.s.):145, 1863.

Cynomys ludovicianus ludovicianus, Hollister, N. Amer. Fauna, 40:14, June 20, 1916; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Swenk, Nebraska Bird Rev., 5:53, July 31, 1937; Smith, Misc. Publ. Mus. Nat. Hist., Univ. Kansas, 16:6, June 17, 1958 (see p. 31); Hall and Kelson, The mammals of North America, p. 365, March 31, 1959.

C[ynomys]. l[udovicianus]. ludovicianus, Jones, Trans. Kansas Acad. Sci., 60:275, October 22, 1957.

Distribution in Nebraska.—Formerly state-wide except extreme eastern part; presently limited to approximately western three-fourths of state. See Fig. 27.

External measurements.—Average and extreme measurements of six males, followed by those of six females, all from western Nebraska are: 407.3 (375-429), 374.2 (362-385); 87.6 (80-93), 77.2 (71-95); 62.2 (58-65), 59.2 (57-63); 17 (one specimen), 12.4[4] (11-14). For cranial measurements see Table 10.

A male and female from Harlan County weighed 3 lbs. and 2 lbs. 4 oz., respectively; a male from Sioux County weighed 1490 grams and one from Thomas County 2 lbs. 2 oz.; three females from Scotts Bluff County weighed 1 lb. 11 oz., 1 lb. 10½ oz., and 1 lb. 15 oz.

Remarks.—*Cynomys ludovicianus* was first described by George Ord in 1815 on the basis of a specimen in Peale's Museum of Philadelphia, which "was certainly" obtained by Lewis and Clark (Hollister, 1916:7-8), and also on the accounts of the species in the Lewis and Clark journals. The exact locality from which the type specimen orignated is unknown and the type locality of *C. ludovicianus* has generally been cited as "Upper Missouri River." Lewis and Clark first observed prairie dogs and obtained specimens along the Missouri River in Nebraska on September 7, 1804. Coues (1893:110-111) quotes from the original journals of the expedition as follows: "At 5½ miles we reached and camped at the foot of a round mountain on the south [bank of the Missouri], having passed two small islands. This mountain [the "Tower" or "Dome" in sec. 10, T. 34 N, R. 10 W, Boyd County], which is about 300 feet at the base, forms a cone at the top, resembling a dome at a distance, and 70 feet or more above the surrounding highlands.

"As we descended from this dome we arrived at a spot, on the gradual descent of the hill, nearly four acres in extent and covered with small holes. These are the residence of a little animal, called by the French petit chien (little dog), which sit erect near the mouth and make a whistling noise, but when alarmed take refuge in their holes. In order to bring them out we poured into one of the holes five barrels of water without filling it, but we dislodged and caught the owner. After digging down another of the holes for six feet, we found, on running a pole into it, that we had not yet dug halfway to the bottom. We discovered, however, two frogs in the hole, and near it we killed a dark rattlesnake which had swallowed a small prairie-dog [unusual because young of the year are essentially full-grown in September—possibly a ground squirrel or some other rodent]; we were also informed, though we never witnessed the fact, that a sort of lizard and a snake live habitually with these animals. The petits chiens are justly named, as they resemble a small dog in some particulars, though they have also some points of similarity to the squirrel. The head resembles the squirrel in every respect, except that the ear is shorter; the tail is like that of the ground-squirrel; the toenails are long, the fur is fine, and the long hair is gray." According to Sgt. John Ordway (see Quaife, 1916:127), Shields, another member of the party, shot at the same place a prairie dog that "was cooked for the captains dinner."

Inasmuch as the original description was based on a specimen obtained by Lewis and Clark, and inasmuch as they first saw and described prairie dogs, and took specimens, at the "Tower" in Boyd County, the type locality of *Cynomys ludovicianus ludovicianus* is here restricted to that place.

The black-tailed prairie dog does not now occur at the restricted type locality but according to local residents did occur there as late as 10 years ago. The species does occur at several nearby localities in Boyd County and specimens examined from these places resemble prairie dogs from other localities in Nebraska.

Records of occurrence.—Specimens examined, 140, as follows: ADAMS COUNTY: no specific locality, 1 (HM). BANNER COUNTY: 20 mi. N Kimball, 2. BOX BUTTE COUNTY: 20 mi. N Bayard, 1 (NSM). BOYD COUNTY: Anoka, 1 (UNDZ); *5 mi. N, 1 mi. W Spencer,* 5; Spencer, 2 (WSC). CHERRY COUNTY: *Ft. Niobrara Nat'l Wildlife Refuge,* 5 (NSM); Valentine, 2 (UNDZ); *5 mi. E Valentine,* 1 (NGFPC); Hackberry Lake, 3 (UMMZ); Kennedy, 3 (USNM); North Fork, Middle Loup River, NW of Mullen, 7 (NSM). CLAY COUNTY: Inland, 1 (NSM); near Clay Center, 1 (NGFPC). CUSTER COUNTY: 2½ mi. NW Victoria Springs, 2 (UMMZ); *5 mi. SE Sargent,* 1 (UNDZ); *5 mi.* S, *2 mi. E Sargent,* 1 (UNDZ); Comstock, 7 (NSM). DAWES COUNTY: 10 mi. S Chadron, 1 (UMMZ); Crawford, 2 (NSM). DUNDY COUNTY: 2 mi. N Parks, 2 (NGFPC); Haigler, 2 (NSM). FILLMORE COUNTY: Geneva, 2 (NSM); 5 mi. SW Shickley, 1 (UNDZ). FRANKLIN COUNTY: Naponee, 15

(NSM). FRONTIER COUNTY: 3½ mi. N Curtis, 1 (UC); 15 mi. SE Stockville, 2 (NSM). GARDEN COUNTY: 16 mi. NW Oshkosh, 3 (NSM); Lisco, 1 (NSM); Oshkosh, 7 (NSM). HARLAN COUNTY: *16 mi. SW Holdrege*, 1 (UC); Alma, 2 (USNM); *Republican City*, 1 (UNDZ). HOOKER COUNTY: Kelso, 1 (UMMZ). KEITH COUNTY: Ogallala, 1 (NSM). LINCOLN COUNTY: Birdwood Creek, 3 (USNM); North Platte, 4 (1 RV, 3 UNDZ); sec. 6, T. 9 N, R. 27 W, approximately 4 mi. N, 6½ mi. W Ingham, 3 (NSM). NUCKOLLS COUNTY: 5 mi. N, ½ mi. E Nelson, 1 (UNM). PIERCE COUNTY: Plainview, 3 (RV). PLATTE COUNTY: Columbus, 1 (USNM). RED WILLOW COUNTY: 5 mi. W Indianola, 1. SCOTTS BLUFF COUNTY: Scottsbluff, 7 (6 AMNH, 1 RV); *2 mi. S, 1 mi. W Scottsbluff, 3900 ft.*, 1; *Scottsbluff Nat'l Monument*, 1 (NSM); 8 mi. S, 3 mi. E Gering, 6 (NSM). SHERIDAN COUNTY: 4 mi. N Antioch, 1 (UMMZ). SIOUX COUNTY: 8 mi. NW Orella, 1 (NSM); 11 mi. N Harrison, 1; Harrison, 2 (NSM); Andrews, 1 (NSM); Running Water Creek, E of Agate, 1 (CM). THOMAS COUNTY: Halsey, 3 (NSM); *Nebraska Nat'l Forest*, 1 (NGFPC). VALLEY COUNTY: 10 mi. S, 2 mi. E Ord, 2 (NGFPC). WEBSTER COUNTY: Bladen, 1 (HM). County unknown: *Nebraska*, 1 (CN-HM); *Platte River*, 3 (USNM).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). BANNER COUNTY: Harrisburg (Gates, 1945:12); Lawrence Fork (Kiener, 1951:237). BOONE COUNTY: Bonanza Flat, 15 mi. NW Albion (Cary, MS). BOYD COUNTY: The Tower, sec. 10, T. 34 N, R. 10 W (see text). BUTLER COUNTY: S of Big Blue River, a few mi. W Ulysses (Jones, 1962:90). CHEYENNE COUNTY: no specific locality (Rapp and Gates, 1957:53). CUMING COUNTY: Plum Creek, near Beemer (Swenk, 1915*a*:5); West Point (Swenk, MS). CUSTER COUNTY: 20 mi. W Broken Bow (Cahalane, 1954:419); 10 mi. S Ansley (Cahalane, 1954:419). DAWES COUNTY: Chadron (Gates, 1945:12). GARDEN COUNTY: Ash Hollow, 3 mi. SE Lewellen (Champe, 1946:44, archeological site). HARLAN COUNTY: Huntley (Gates, 1945:12). HOLT COUNTY: a few mi. W Atkinson (Cary, MS). KEARNEY COUNTY: Ft. Kearney (J. A. Allen, *in* Coues and Allen, 1877:889, 901). KIMBALL COUNTY: no specific locality (Rapp and Gates, 1957:53). KNOX COUNTY: near Ponca Creek (Jones, 1962:90); *mouth of Niobrara River* (Hayden, 1859:709); about 10 mi. below mouth of Niobrara River (Hayden, 1863:145); *near Santee* (Jones, 1962:90). MERRICK COUNTY: between Loup and Platte rivers (Jones, 1962:90). PHELPS COUNTY: Funk (Swenk, MS). PLATTE COUNTY: near Monroe (Cary, MS). SALINE COUNTY: S of Wilber (Jones, 1962:90). VALLEY COUNTY: *¾ mi. N, 6 mi. W North Loup* (Hill and Kivett, 1941:183, archeological site). WASHINGTON COUNTY: Clark Creek, near Fontanelle (Swenk, 1915*a*:5). WAYNE COUNTY: 2 mi. N Wayne (Jones, 1962:90). YORK COUNTY: near York (Swenk, MS). County unknown: *Republican River* (J. A. Allen, *in* Coues and Allen, 1877:898—of the three specimens listed under this locality from Kansas, one, USNM 1914, obtained on October 7, 1856, is actually from Nebraska).

Sciurus carolinensis

Gray Squirrel

The gray squirrel is an inhabitant of the deciduous forests of eastern North America; the line marking the western limit of the range of the species passes through Nebraska. Formerly *S. carolinensis* occurred all along the eastern border of the state and westward in the southeastern part along the wooded valleys of tributaries of the Missouri River. The distribution in Nebraska was correlated with, though not entirely restricted to, the oak-hickory association. Presently the species is limited to the more heavily wooded areas along the Missouri in southeastern Nebraska.

The most northerly record in Nebraska is from along the Missouri River in Cedar County (Cary, MS). Lewis and Clark reported the gray squirrel along the Missouri "as high up as the little Sieoux *[sic]* R[iver]" (Thwaites, 1905:122) opposite central Burt County, and James (1823:370) recorded the species at the Engineer Cantonment of Major Long in Washington County in the winter of 1819-1820. Swenk (1908:80) reported *carolinensis* as: "Common in the timber along the watercourses of southeastern Nebraska, but greatly outnumbered everywhere by *[Sciurus niger] rufiventer.* I have no records west of the 97th meridian nor north of the Platte." Just what "records" Swenk was referring to is unclear, because his collections contain no specimens of this species nor are any specific localities mentioned in his unpublished notes on Nebraskan mammals.

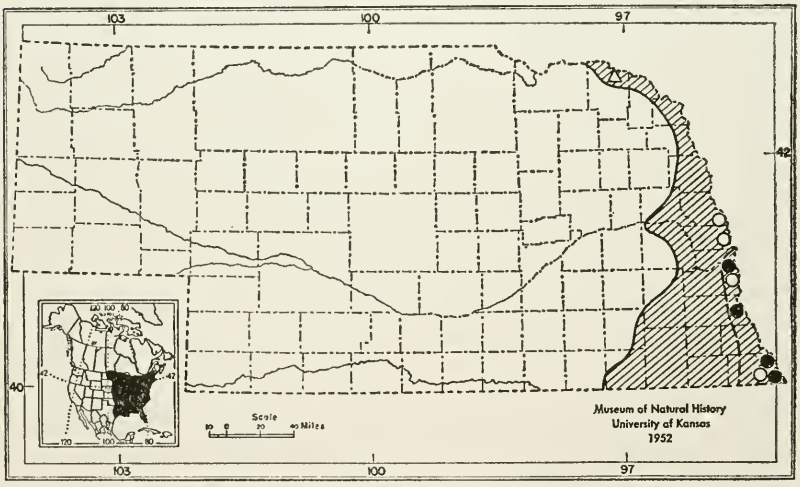

FIG. 28. Distribution of *Sciurus carolinensis pennsylvanicus* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate western limit of present distribution.

Where it occurs in Nebraska, the gray squirrel is usually less numerous than the fox squirrel, *Sciurus niger.* Individuals are more or less restricted to heavy stands of deciduous timber where they are most active in the early morning and late afternoon, rarely in the middle of the day except on cloudy days. On occasion the species is found in some abundance. In October, 1956, J. R. Alcorn, W. L. Cutter, T. A. Vaughan and I found it common, perhaps more so than *S. niger,* along the wooded bluffs of the Missouri River, 4 mi. E Barada.

Cary (MS) reported a "possibly introduced" pair of gray squirrels taken in a grove near Warnerville, Madison County, in 1905. I have not admitted this record.

Females may breed twice yearly, once in late winter or early spring, and again in summer. The number of young per litter is 1-4 according to Asdell (1946:219).

Sciurus carolinensis pennsylvanicus Ord

Sciurus Pennsylvanica Ord, *in* Guthrie, A new geographical, historical, and commercial grammar . . ., ed. 2, 2:292, 1815 (type locality, "those parts of Pennsylvania which lie to the westward of the Allegany ridge").

Sciurus carolinensis pennsylvanicus, Rhoads, Amer. Nat., 28:525, June, 1894; Jones and Cortner, Trans. Kansas Acad. Sci., 63:288, January 11, 1961.

Sciurus cinereus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823.

Sciurus carolinensis, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):256, July 14, 1858; Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:708, 1859; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 92, 1875; Velich, Jour. Mamm., 42:92, February 20, 1961.

Sciurus Carolinensis, Hayden, Trans. Amer. Philos. Soc., 12(n.s.):144, 1863.

[Sciurus carolinensis] var. *leucotis,* J. A. Allen, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:700, August, 1877.

S[ciurus]. Carolinensis, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Sciurus carolinenesis [sic], Swenk, Proc. Nebraska Acad. Sci., 8:80, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:24, September, 1908.

Sciurus carolinensis carolinensis, Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Jones and Webb, Jour. Mamm., 30:312, August 17, 1949; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:482, April 21, 1954; Velich, Jour. Mamm., 39:148, February 20, 1958; Hall and Kelson, The mammals of North America, p. 370, March 31, 1959.

S[ciurus]. c[arolinensis]. carolinensis, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Formerly in deciduous woodlands in eastern Nebraska north at least to Cedar County; presently limited to vicinity of Missouri River in southeastern part of state. See Fig. 28.

External measurements.—Average and extreme measurements of 10 adults (five males, five females) from 4 mi. E Barada are: 470.5 (447-498); 212.5 (189-233); 66.5 (62-70); 32.8[6] (32-35). For cranial measurements see Table 10.

Packard (1956:46) recorded the weight of adult males in Kansas as 500-628 grams.

Remarks.—Although J. A. Allen (*in* Coues and Allen, 1877:700) used the subspecific name *leucotis* [= *pennsylvanicus*] for a gray squirrel from Nebraska, subsequent authors employed S. *c. carolinensis,* evidently on geographic grounds because none studied speci-

mens critically. Jones and Cortner (1961:285-288) compared specimens from Nebraska with typical individuals of both *pennsylvanicus* and *carolinensis,* found that they agreed with *pennsylvanicus* in external and cranial measurements and approached it in average color (being only slightly less grayish in winter pelage), and thus applied the name S. *c. pennsylvanicus* to the gray squirrel in Nebraska.

An adult male (KU 55233) from 3 mi. S and 2 mi. E Nebraska City has an extra premolarlike tooth in the left upper toothrow. This supernumerary tooth lies lingual to the junction of P3 and P4 and is more than twice the size of the former, but only about one-third as large as the latter. It is definitely not a left-over deciduous P4, differing in both size (smaller) and construction from that tooth.

Records of occurrence.—Specimens examined, 14, as follows: CASS COUNTY: mouth of Platte River, 1 (USNM). OTOE COUNTY: 3 mi. S, 2 mi. E Nebraska City, 1. RICHARDSON COUNTY: 4 mi. E Barada, 11; 2 mi. S, 4 mi. E Rulo, 1.

Additional records (Cary, MS, unless otherwise noted): CASS COUNTY: Rock Bluff (Velich, 1958:148). CEDAR COUNTY: no specific locality. DOUGLAS COUNTY: Paddock's Grove (Omaha). OTOE COUNTY: *Nebraska City; within 3 mi. Nebraska City* (Velich, 1961:92). RICHARDSON COUNTY: *Barada* (Jones and Webb, 1949:312); Falls City; *vicinity Rulo* (Jones and Webb, 1949:312). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:370).

Sciurus niger

Fox Squirrel

The fox squirrel is a common resident of timbered areas, woodlots, hedgerows, and urban communities in eastern Nebraska. The species occurs also in the western part of the state but its distribution there is essentially dendritic along the major river systems—the Niobrara, Platte, and Republican. Many of the areas where the fox squirrel lives in western Nebraska have been occupied relatively recently, owing to invasion from the east or to introduction or both. In northern Nebraska S. *niger* ranges nearly to the western border of the state along the Niobrara and does so along the North Platte; it is found also in deciduous communities in drainages of the Hat Creek Basin and the White River. The species occurs all along the South Platte and Republican in southern Nebraska and on into Colorado.

The spread of the fox squirrel westward in Nebraska along the major drainages is not so well documented as might be hoped but is clearly indicated by comparison of the present distribution of the species with that of the early 1900's. Swenk (1908:80) wrote of S. *niger:* "Abundant in eastern Nebraska, but practically confined to the timber bordering the Missouri river and its tributaries, west to

about the 98th meridian southwardly but not so far northwardly, except in the Niobrara valley, where it occurs west into Holt county." Cary (MS, about 1905) wrote: "It is a notable fact that the fox squirrel has extended its range during recent years. At Neligh . . . squirrels were of rare occurrence previous to 1895. Now they are abundant throughout the upper Elkhorn valley." Furthermore, I have found no indication in historical accounts of western Nebraska that any kind of tree squirrel occurred there.

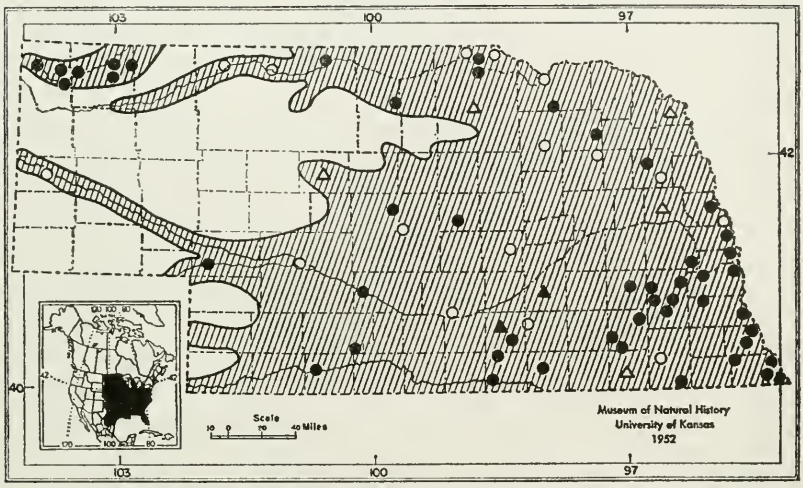

FIG. 29. Distribution of *Sciurus niger rufiventer* in Nebraska. For explanation of symbols see Fig. 5.

The fox squirrel also has moved up the Missouri River within historic time. Lewis and Clark noted upon their return down the Missouri in 1806: "In passing the Dome [or Tower, in northeastern Boyd County] and the first village of barking squirrels [prairie dogs], we stopped and killed two fox-squirrels, an animal which we had not seen on the river higher than this place" (Coues, 1893: 1199). Later, Hayden (1859:708), discussing his explorations in Nebraska and adjacent areas in the late 1850's, wrote of *S. niger:* "Very abundant around Council Bluffs [Iowa]. Gradually becomes rare, and ceases near the mouth of the White River [South Dakota]." Presently the fox squirrel occurs all along the Missouri in South Dakota and in much of the Missouri drainage of North Dakota.

Dispersal of the fox squirrel westward along river systems in the Great Plains and successful introduction of the species in places where it did not formerly occur result largely from conditions

created by man. Protected from prairie fires, deciduous riparian communities, consisting mostly of cottonwood and willow but having some boxelder and elm, have matured along river bottoms where only isolated stands or none at all occurred 100 years ago. Too, early settlers planted trees in newly founded towns and to create rural groves and wind breaks. Perhaps even more important to the fox squirrel was the availability of food, principally corn but also small grains, owing to cultivation of the river valleys. Hibbard (1957:525-527) in North Dakota, Hoover and Yeager (1953:359-360) in Colorado, and Packard (1956:8) in Kansas also have reported westward extension of the range of the fox squirrel in recent years.

As noted above, introductions are at least in part responsible for extension of range in S. *niger*. Hoover and Yeager (*loc. cit.*) surmised that both "stocking" and natural invasion were responsible for the establishment of fox squirrel populations along the South Platte River in Colorado. Hibbard (*loc. cit.*) attributed the spread of the species in North Dakota both to introduction and invasion. I know definitely of two introductions in Nebraska; probably many others occurred of which no record was kept. According to Swenk (MS), Rees Heaton introduced fox squirrels from Kansas along Medicine Creek near Curtis about 1902, where the species did not then occur. D. W. Lindeman, who farms with his brother on Deadmans Creek, 7 mi. S and 3½ mi. W Crawford, reported to me that his father introduced a pair of fox squirrels there in 1908 from Cass County, Iowa. Prior to that time squirrels were unknown to Lindeman along the streams of the Pine Ridge in eastern Sioux and western Dawes counties. Today S. *niger* is common on Deadmans Creek and other tributaries of the White River and occurs also in the Hat Creek Basin. Lindeman's dogs killed 26 squirrels in the winter of 1956-57 in one building where corn was stored.

The population of S. *niger* in the valleys of the Pine Ridge and adjacent areas to the north could be entirely descendent from introduced animals. It is doubtful that fox squirrels reached the Pine Ridge along the valley of the White River of South Dakota but it is possible that individuals reached the area from the valley of the Niobrara River to the south.

Females usually breed twice annually, once in late winter or early spring and again in late spring or early summer. The number of young per litter ranges from 1-6 (Asdell, 1946:220) but usually is 2 or 3.

Sciurus niger rufiventer É. Geoffroy St.-Hilaire

Sciurus rufiventer É. Geoffroy St.-Hilaire, Catalogue des mammiféres der Museum National d'Histoire Naturelle, Paris, p. 176, 1803 (type locality, somewhere in the Mississippi Valley, probably between southern Illinois and central Tennessee according to Osgood, Proc. Biol. Soc. Washington, 20:44, April 18, 1907); Swenk, Proc. Nebraska Acad. Sci., 8:80, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:24, September, 1908.

Sciurus niger rufiventer, Osgood, Proc. Biol. Soc. Washington, 20:44, April 18, 1907; Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:27, October, 1936; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949.

Sciurus macrurus (misspelled *macroura*), James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:115, 1823 (part).

[Sciurus] capistratus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823 (part).

[Sciurus] nigra, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823 (part).

Sciurus ludovicianus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

S[ciurus]. n[iger]. rufiventer, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Widely distributed in eastern part of state; also along major drainage systems in western part and streams of Pine Ridge area. See Fig. 29.

External measurements.—Average and extreme measurements of 10 specimens (eight males, two females) from Lancaster and Richardson counties are: 511.1 (490-528); 233.8 (219-245); 71.2 (67-76); 30.6[9] (27-32). Corresponding measurements for six specimens (two males, four females) from Dawes and Sioux counties are: 499.3 (490-510); 209.5 (210-225); 69.1 (64.5-73); 29.5 (25-32). For cranial measurements see Table 10.

A male from Lancaster County weighed 622.3 grams. Two males and two females from the vicinity of Crawford weighed, respectively: 594.8, 690.0, 700.0, 670.0.

Remarks.—Specimens from along the Niobrara River in the vicinity of Valentine and from along streams of the Pine Ridge country to the west differ in several ways from specimens of *S. n. rufiventer* from eastern Nebraska. The squirrels from the northwestern part of the state average smaller cranially and slightly smaller externally (see measurements), and are paler over-all, but especially on the neck, feet, and tail. The latter is straw color or pale ochraceous orange ventrally rather than reddish orange. A specimen from 5 mi. WSW Ogallala (KU 76917), saved as a skull only, agrees with specimens from northwestern Nebraska in small external and cranial dimensions and perhaps small, pale-colored squirrels occur also in the western Platte Valley.

The theory that fox squirrels in the western Niobrara Valley and

Pine Ridge areas represent a distinct subspecies is a tempting one, but is tempered by two major considerations. First of all, specimens from the western reaches of other river systems on the Great Plains differ, at least in being paler, from typical specimens of *S. n. rufiventer.* This is true of specimens from the Republican drainage (Cheyenne, Decatur, Rawlins, and Thomas counties, Kansas), the Arkansas drainage (Hamilton, Finney, and Kiowa counties, Kansas), the Cimarron drainage (Meade County, Kansas), and the Canadian drainage in the Texas Panhandle (W. L. Cutter, personal communication). Possibly populations of fox squirrels along other river systems are pale-colored as well. Obviously these pale populations have no geographic continuity and the gene-flow of each is eastward along the rivers to the main range of *S. n. rufiventer.* Seemingly squirrels in the dendritic western segments of the range of *rufiventer* are adapting through natural selection in similar ways to similar environments.

Secondly, insofar as information now available indicates, fox squirrels have only recently occupied these western areas, either through invasion or through introduction, or both. Mostly this has taken place in the last half century and one must consider the genetic basis of change in so short a period. Furthermore, few specimens are available from most of the areas mentioned. Until additional material is available from the Great Plains it seems best to refer the squirrels under discussion to the subspecies *rufiventer.*

Records of occurrence.—Specimens examined, 119, as follows: ADAMS COUNTY: Ayr, 1 (HM); no specific locality, 2 (HM). BOYD COUNTY: Spencer, 1 (UNDZ). BROWN COUNTY: Long Pine, 1 (Stanford Univ.). CASS COUNTY: Plattsmouth, 1 (RV); South Bend, 1 (NSM). CHERRY COUNTY: Valentine, 4 (USNM); *Ft. Niobrara Nat'l Wildlife Refuge,* 4 (NSM). CUMING COUNTY: 1 mi. S Beemer, 1. CUSTER COUNTY: Victoria Springs, 1 (UMMZ). DAWES COUNTY: 12 mi. E Chadron, 1 (UMMZ); Chadron, 1 (CSTC); 2 mi. W Horn, 1 (NSM); 10 mi. S Chadron, 2 (UMMZ); *3 mi. W Crawford,* 3 (NSM). DAWSON COUNTY: *4 mi. E Gothenburg,* 1 (UC); ½ mi. S Gothenburg, 1. DOUGLAS COUNTY: Omaha, 1 (RV). FRONTIER COUNTY: 17 mi. SE Stockville, 1 (NSM). GAGE COUNTY: Barnston, 1 (NSM); *2 mi. S, ½ mi. E Barnston,* 1. HAMILTON COUNTY: no specific locality, 1 (HM). HOLT COUNTY: 10 mi. SE Butte, 1 (WSC). KEITH COUNTY: 5 mi. WSW Ogallala, 1. KNOX COUNTY: Creighton, 1 (NSM). LANCASTER COUNTY: mouth of Rock Creek, Waverly, 1 (NGFPC); Woodlawn, 1 (NSM); *Lincoln,* 26 (1 MVZ, 1 NGFPC, 6 NSM, 2 UNDZ, 16 UC); *3 mi. E Lincoln,* 1; *5 mi. E Lincoln,* 1 (UNDZ); 2 mi. S, 8 mi. E Lincoln, 1 (UC); *5 mi.* S, *2 mi. E Lincoln,* 1 (UC); *6 mi. S Lincoln,* 1 (UC); 7 mi. S, 2 mi. W Lincoln, 1 (UC); *Jamaica, 8 mi. S Lincoln,* 1 (MVZ); *Hanlon,* 1 (NSM); Roca, 1 (NSM); *no specific locality,* 1 (UC). NEMAHA COUNTY: 3 mi. S, 1½ mi. E Peru, 1; Auburn, 1 (USNM); *London,* 1 (USNM). NUCKOLLS COUNTY: ½ mi. S, 2 mi. W Nelson, 1 (UNM). OTOE COUNTY: 4 mi. S, 18½ mi. E Lincoln, 1 (UC); 3 mi. S, 2 mi. E Nebraska City, 3. PIERCE COUNTY: 15 mi. N Norfolk, 2 (UC). RED WILLOW COUNTY: McCook, 2 (NSM). RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 2; 4 mi. E Barada, 5; 4 mi. N, 4 mi. E Falls City, 1 (NGFPC); *Rulo,* 1 (WSC); 3 mi. SE Rulo, 3 (NGFPC). SALINE COUNTY: Crete, 1 (UNDZ); 4 mi. N Tobias, 1 (MVZ); Western, 1 (UNDZ). SARPY COUNTY:

Bellevue, 1 (RV). SAUNDERS COUNTY: SE corner, 5 (NSM). SEWARD COUNTY: 6 mi. E Seward, 1 (UC). SIOUX COUNTY: Monroe Canyon, 2 (NSM); 1-1½ mi. N, 10 mi. W Crawford, 2 (1 NSM); *7 mi. W Crawford*, 3 (NSM); 3 mi. E Glen, 1 (NSM). VALLEY COUNTY: 11 mi. W North Loup, 1 (UNDZ). WASHINGTON COUNTY: Blair, 1 (RV). WEBSTER COUNTY: Bladen, 1 (HM); Inavale, 1 (HM).

Additional records: ADAMS COUNTY: *Logan Twp.* (Swenk, MS). ANTELOPE COUNTY: Neligh (Cary, MS). BOYD COUNTY: Anoka (Swenk, MS); the Tower, sec. 10, T. 34 N, R. 10 W (see text). BROWN COUNTY: *Long Pine Canyon* (Swenk, MS). BUFFALO COUNTY: Kearney (Jones, fieldnotes). CHERRY COUNTY: Niobrara River, S of Merriman (Cary, MS); 12 mi. S Cody (Cary, MS). CLAY COUNTY: Inland (Swenk, MS). CUMING COUNTY: West Point (Swenk, 1908:80). CUSTER COUNTY: vicinity Broken Bow (Swenk, MS). DAKOTA COUNTY: no specific locality (Rapp and Gates, 1957:53). DODGE COUNTY: no specific locality (Rapp and Gates, 1957:53). GAGE COUNTY: Beatrice (Swenk, 1908:80). HOLT COUNTY: no specific locality (Swenk, 1908:80). HOWARD COUNTY: St. Paul (Swenk, MS). JEFFERSON COUNTY: no specific locality (Rapp and Gates, 1957:53). KNOX COUNTY: Niobrara (Swenk, 1908:80). LINCOLN COUNTY: 3 mi. W North Platte (Swenk, MS). MADISON COUNTY: Norfolk (Swenk, 1908:80). RICHARDSON COUNTY: *Falls City* (Swenk, 1908:80); *vicinity Rulo* (Jones and Webb, 1949:313). SCOTTS BLUFF COUNTY: Scotts Bluff Nat'l Monument (Mattes, 1958:57). THOMAS COUNTY: no specific locality (Smith, 1958:60). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:370). WEBSTER COUNTY: *Red Cloud* (Swenk, MS).

Glaucomys volans

Southern Flying Squirrel

The southern flying squirrel is an inhabitant of the woodlands along the Missouri River in southeastern Nebraska. Probably the species was more widely distributed in the southeastern part of the state at a time when the deciduous association was more widespread

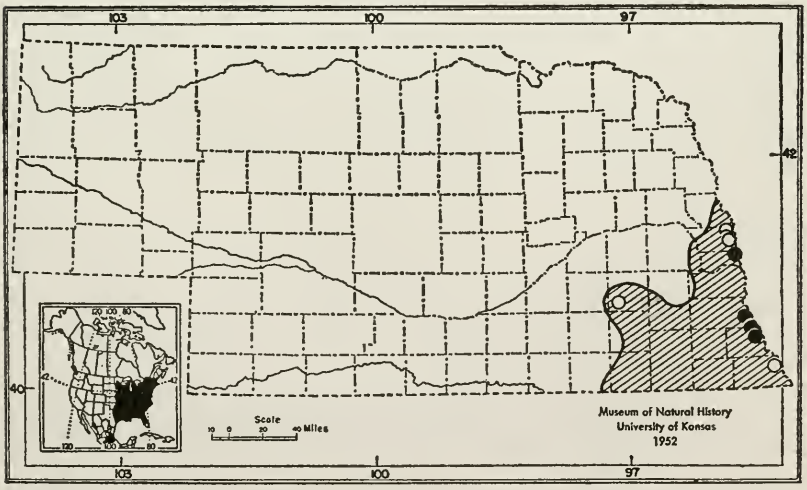

FIG. 30. Distribution of *Glaucomys volans volans* in Nebraska. For explanation of symbols see Fig. 5.

than now. Although uncommon in most areas, *G. volans* is apparently relatively abundant in the vicinity of Peru where J. R. Alcorn took a specimen in 1958 and where one or more are usually captured each year on the campus of Peru State Teachers College. A farmer who lives 4 mi. E Barada informed me in 1956 that flying squirrels were still seen occasionally in that area and Velich (1954: 429) reported animals seen or taken in Sarpy County in 1950 and in Douglas County in 1952.

Females may breed several times each year according to Asdell (1946:216), usually twice, and bear 1-4 young per litter.

Glaucomys volans volans (Linnaeus)

[Mus] volans Linnaeus, Systema naturae, ed. 10, 1:63, 1758 (type locality restricted to Virginia by Elliot, Field Columb. Mus., Zool. Ser., 2:109, 1901).

[Glaucomys] volans, A. H. Howell, Proc. Biol. Soc. Washington, 28:109, May 27, 1915.

Pteromys volucella, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Pteromys volans volans, Swenk, Nebraska Blue Book, p. 852, 1915.

Pteromys volans nebrascensis Swenk, Univ. Nebraska Studies, 15:151, September 25, 1915 (type locality, Nebraska City, Otoe Co., Nebraska).

Glaucomys volans nebrascensis, Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920.

Glaucomys volans volans, A. H. Howell, N. Amer. Fauna, 44:19, June 13, 1918; Velich, Jour. Mamm., 35:429, August 20, 1954; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:268, March 3, 1955; Hall and Kelson, The mammals of North America, p. 407, March 31, 1959.

G[laucomys]. v[olans]. volans, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Southeastern part of state, north certainly to Douglas County and west certainly to Seward County; probably presently restricted principally to wooded areas along Missouri River. See Fig. 30.

External measurements.—Measurements of an adult male from Nebraska City, followed by those of an adult female from 1 mi. NNW Peru, are: 240.5, 242; 115, 111; 30.5, 31; 18 (crown), 19. For cranial measurements see Table 10. A female from Ft. Leavenworth, Kansas, weighed 102.8 grams.

Remarks.—*"Pteromys volans nebrascensis,"* named by Swenk (1915*b*:151), was said to differ from *Glaucomys volans volans* in being larger, and in having a longer tail, darker feet and toes, and slightly larger and more rounded auditory bullae. I concur with A. H. Howell (1918:22-23) and Cockrum (1952:134) that *nebrascensis* is a synonym of *volans.*

Records of occurrence.—Specimens examined, 7, as follows: NEMAHA COUNTY: 1 mi. NNW Peru, 1. OTOE COUNTY: Nebraska City, 2 (1 MVZ, 1 NSM); 10 mi. SE Nebraska City, 3 (HM). SARPY COUNTY: Fontanelle Forest, 1 (RV).

Additional records: DOUGLAS COUNTY: Florence (Velich, 1954:429); Omaha (Cary, MS); *South Omaha Bridge* (Velich, 1954:429). NEMAHA

COUNTY: *Peru* (Swenk, 1908:88). OTOE COUNTY: *near Nebraska City* (Taylor, 1888:745). RICHARDSON COUNTY: 4 mi. E Barada (see text above). SARPY COUNTY: Bellevue (Cary, MS). SEWARD COUNTY: Beaver Crossing (Swenk, MS).

TABLE 10.—CRANIAL MEASUREMENTS OF CYNOMYS, SCIURUS, AND GLAUCOMYS.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Condylobasal length	Zygomatic breadth	Postorbital constriction	Length of nasals	Length of maxillary tooth-row	Depth of skull
Cynomys ludovicianus ludovicianus, Scotts Bluff County							
3277 NSM, ♀	59.7	55.7	43.2	14.4	21.5	17.0	26.1
3280 NSM, ♀	61.1	.....	45.0	14.9	22.6	16.5	.....
3319 NSM, ♂	62.1	59.2	45.1	13.7	23.0	17.5	27.6
10 mi. S, 2 mi. E Ord, Valley County							
32 NGFPC, ♀	64.5	61.3	45.0	12.5	24.5	17.1	26.3
350 NGFPC, ♀	63.3	61.3	45.1	11.9	23.6	18.0	27.7
Sciurus carolinensis carolinensis, 4 mi. E Barada, Richardson County							
Average 10 (5♂, 5♀)	62.2	57.3[9]	35.0	19.0	20.8	11.3	26.0
Minimum	60.2	56.0	33.6	18.0	20.0	11.0	25.4
Maximum	63.6	58.4	36.3	19.9	21.6	11.6	26.5
Sciurus niger rufiventer, Lancaster and Richardson counties							
Average 10 (7♂, 3♀)	64.0	59.7	35.7	19.9	21.9	11.4	26.7
Minimum	63.0	57.7	33.9	19.2	20.8	10.9	25.2
Maximum	65.5	61.8	37.3	20.5	22.6	11.9	27.8
vicinity Valentine, Cherry County							
Average 7 (6♂, 1♀)	61.3	56.6	34.5	19.5	21.1	11.2	26.0
Minimum	60.5	56.1	33.2	19.0	20.5	10.9	25.4
Maximum	62.0	57.2	35.3	19.8	21.8	11.7	26.6
Dawes and Sioux counties							
Average 5 (2♂, 3♀)	61.6	57.5	34.5	19.6	21.3	11.2	26.6
Minimum	60.7	56.8	34.0	18.7	20.6	10.8	25.8
Maximum	63.6	58.1	35.0	20.4	23.0	11.5	27.3
Glaucomys volans volans, 1 mi. NNW Peru, Nemaha County							
77949 KU, ♀	35.6	33.0	21.5	9.0	9.9	6.8	16.5

Family GEOMYIDAE—Pocket Gophers

KEY TO NEBRASKAN POCKET GOPHERS

1. Hind foot less than 30; anterior face of upper incisor smooth; enamel present on posterior occlusal face of upper premolar.
   Thomomys talpoides, p. 152

1′. Hind foot 30 or (usually) more; anterior face of upper incisor grooved; enamel lacking on posterior occlusal face of upper premolar.
   Geomys bursarius, p. 155

Thomomys talpoides

Northern Pocket Gopher

The northern pocket gopher occurs in Nebraska only in the extreme northwestern and southwestern parts of the Panhandle. In the northwest it seemingly replaces *Geomys bursarius* in the Pierre soils north of the Pine Ridge and White River. In the southwest the species occurs along with *G. bursarius* in the Rosebud soils on the Cheyenne Table but *Thomomys* has always been taken there on higher ground, never in the valleys.

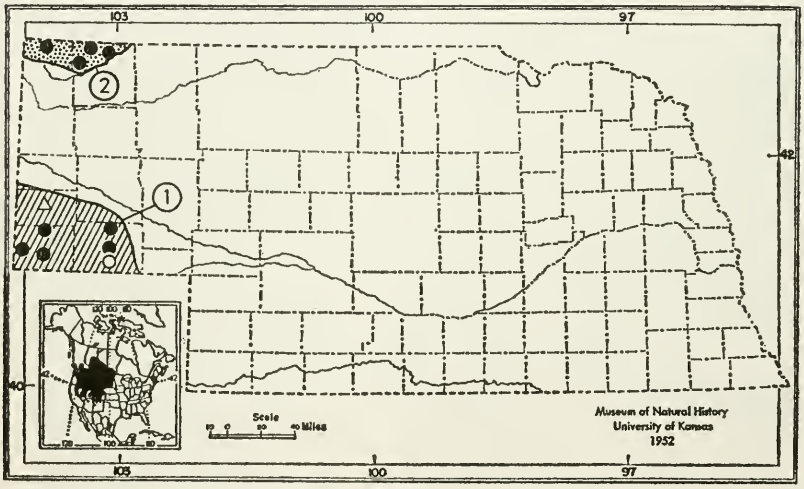

FIG. 31. Distribution of *Thomomys talpoides* in Nebraska. 1. *T. t. cheyennensis.* 2. *T. t. pierreicolus.* For explanation of symbols see Fig. 5.

Evidently *Thomomys talpoides* is not so common now as formerly in the southwestern Panhandle. Swenk (1940*a*:7), whose comments were based largely on field work conducted in 1919, noted that *G. bursarius* was entirely absent on the uplands of the Cheyenne Table "where it is replaced by *Thomomys.*" In the summer of 1945 a field party from the University of Kansas Museum of Natural History spent several days trapping in the vicinity of Dalton in an attempt to secure specimens of *T. t. cheyennensis.* Members of the party trapped in all available upland soil types but took only *G. bursarius.* Probably the turning of the upland prairie for cultivation, principally for wheat, has severely restricted *T. talpoides* on the Cheyenne Table in the past several decades and has facilitated invasion by *G. bursarius* of upland habitats.

Females probably breed only once annually; the litter is born in spring or early summer. According to Tryon (1947:19) an unstated number of females from the Bridger Mountains, Montana, carried an average of 4.4 embryos per pregnancy.

Thomomys talpoides cheyennensis Swenk

Thomomys talpoides cheyennensis Swenk, Missouri Valley Fauna, 4:5, March 1, 1941 (type locality, 2 mi. S Dalton, Cheyenne Co., Nebraska); Hall, Univ. of Kansas Publ., Mus. Nat. Hist., 5:30, February 28, 1951; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:311, March 3, 1955; Hall and Kelson, The mammals of North America, p. 437, March 31, 1959.

Thomomys clusius clusius, Swenk, Nebraska Blue Book, p. 852, 1915.

Thomomys talpoides clusius, Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

T[homomys]. t[alpoides]. cheyennensis, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Known only from southwestern part of Panhandle. See Fig. 31.

External measurements.—Measurements of the holotype, a male, and two females from Kimball County are, respectively: 225, 225, 212; 66, 66, 63; 29, 26, 29; —, —, 5. For cranial measurements see Table 11.

Remarks.—From *Thomomys talpoides pierreicolus* of northwestern Nebraska, *T. t. cheyennensis* differs in being paler, larger (both externally and cranially), and in having proportionately longer rostrum and nasals, more highly arched skull over the naso-frontal suture, less procumbent upper incisors, larger teeth, and larger auditory bullae but smaller external auditory meatuses. In all probability the geographic ranges of these two subspecies do not meet. *T. t. cheyennensis* occurs only in the southwestern part of the Nebraska Panhandle and at several places in the immediate vicinity of Pine Bluffs, Wyoming, just over the Nebraska border (Hall and Montague, 1951:30).

V. Bailey (1915:100, footnote) suggested that the specimen on which the name *Geomys borealis* Bachman, 1839 (not *Geomys borealis* Richardson, 1837), was based was the one mentioned in Townsend's narrative as having been obtained near the prominent land mark of Scotts Bluff, in the present county of the same name. Bailey examined the specimen in question and identified it as *Thomomys talpoides clusius.* Because the species *talpoides* is not otherwise known from Scotts Bluff County, I suppose that the specimen mentioned by Townsend was instead *Geomys bursarius,* which is common in the vicinity of Scotts Bluff. Should *T. talpoides* be found to occur at Scotts Bluff, specimens would most likely be assignable to *T. t. cheyennensis,* known from the next county south-

ward in Nebraska, or to *T. t. attenuatus,* known from as near as 5 mi. SW Wheatland, Wyoming.

Records of occurrence.—Specimens examined, 7, as follows: CHEYENNE COUNTY: 2 mi. S Dalton, 2 (1 MVZ, 1 NSM); 4 mi. N Sidney, 1 (NSM). KIMBALL COUNTY: 10 mi. N Kimball, 2 (NSM); Smeed, 1; 9 mi. S Kimball, 1 (NSM).

Additional records: BANNER COUNTY: no specific locality (Fichter, 1941:28). CHEYENNE COUNTY: 4 mi. S Sidney (Swenk, MS). KIMBALL COUNTY: *5 mi. S Kimball* (Swenk, MS); *7 mi. S Kimball* (Swenk, MS).

Thomomys talpoides pierreicolus Swenk

Thomomys talpoides pierreicolus Swenk, Missouri Valley Fauna, 4:2, March 1, 1941 (type locality, Wayside, Dawes Co., Nebraska); Miller and Kellogg, Bull. U. S. Nat. Mus., 205:311, March 3, 1955; Hall and Kelson, The mammals of North America, p. 443, March 31, 1959.

Themomys [sic] talpoides, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Thomomys talpoides, Swenk, Proc. Nebraska Acad. Sci., 8:107, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:51, September, 1908.

Thomomys talpoides nebulosus, Swenk, Nebraska Blue Book, p. 852, 1915.

Thomomys talpoides bullatus, Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

T[homomys]. t[alpoides]. pierreicolus, Jones, Tran. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Known only from extreme northwestern Nebraska. See Fig. 31.

External measurements.—Measurements of four adult topotypes, one male and three females, are, respectively: 205, 201, 198, 195; 52, 52, 56, 57; 28, 26, 26, 28; 6, 6, 7, 6. For cranial measurements see Table 11. Respective weights in grams of the four topotypes were: 100.7, 94.0, 88.4, 87.8.

Remarks.—For comparison with *Thomomys talpoides cheyennensis,* see account of that subspecies.

T. t. pierreicolus is restricted in Nebraska to soils of the Pierre series north of the Pine Ridge in Sioux County and north of the White River in Dawes County. Cary (1902:69) recorded it from northern Sioux County "in both Upper Sonoran and Transition Zones" but, as Swenk (1941:1) pointed out, this statement was based on a single skull picked up along Indian Creek. The subspecies occurs in much of western South Dakota.

Imler (1945:272, footnote) noted that one of the pocket gophers caught in snake traps at Crescent Lake National Wildlife Refuge, Garden County, in the summer of 1940, was a member of the genus *Thomomys.* Crescent Lake Refuge lies near the western edge of the Sand Hills and nearer the known geographic range of *T. t. cheyennensis* than that of *T. t. pierreicolus.* Because the specimen was not preserved I have not admitted Imler's record here, but future investigations would be worthwhile to determine whether or not

Thomomys talpoides actually occurs directly north of the Platte River in the Panhandle.

A third subspecies of the northern pocket gopher, *Thomomys talpoides rufescens,* may occur in Nebraska. It has been reported from old Ft. Randall, South Dakota (V. Bailey, 1915:99), only five miles north of the Nebraska border (Boyd County). Swenk (MS), however, made a fairly thorough search for pocket gophers in northern Boyd County in August, 1919, and found only *Geomys bursarius.*

Records of occurrence.—Specimens examined, 31, as follows: DAWES COUNTY: Wayside, 27 (1 MVZ, 5 NSM); 5 mi. NW Chadron, 2 (NSM); Sand Creek Valley, NE of Horn, 1 (NSM). SIOUX COUNTY: Indian Creek, N of Story, 1 (NSM).

Geomys bursarius

Plains Pocket Gopher

The plains pocket gopher is state-wide in distribution and is common, often abundant, throughout most of Nebraska. In the eastern, intensely cultivated part of the state the species now occurs mostly in pastures and other fallow lands, and in alfalfa fields.

Five different subspecific names have been proposed for specimens of *Geomys bursarius* from Nebraska, based principally on supposed differences between specimens from different types of soil; only two of these names are recognized beyond. Myron H. Swenk (1939, 1940*a*) named four of the five kinds and the reader is referred to his papers for analysis of the distribution of *G. bursarius* in relation to soils.

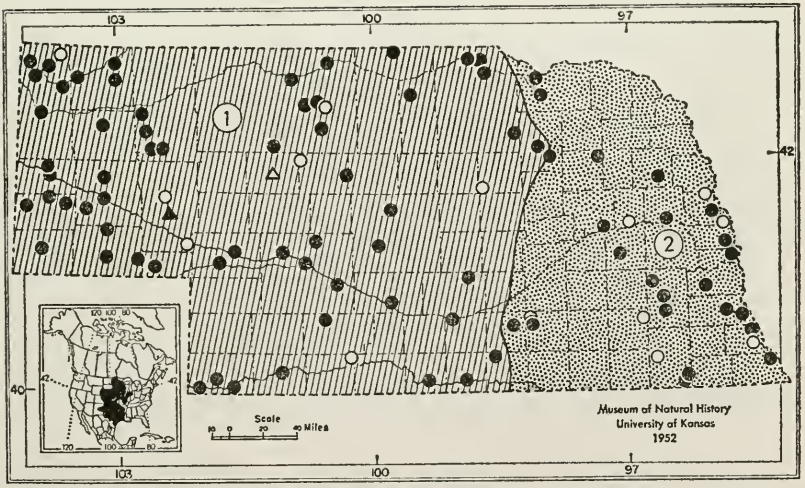

FIG. 32. Distribution of *Geomys bursarius* in Nebraska. 1. *G. b. lutescens.* 2. *G. b. majusculus.* For explanation of symbols see Fig. 5.

Thirteen females taken in the months of April through July carried an average of 3.6 (2-6) embryos. Lactating females have been collected in April and June. Inasmuch as pregnant females have been obtained as early as January (in Kansas, T. Scheffer, 1910:204), the current theory that females bear but a single litter annually may be in error.

Of the 487 specimens of *Geomys bursarius* examined, three, all of the subspecies *G. b. majusculus*, were albinos.

Geomys bursarius lutescens Merriam

Geomys bursarius lutescens Merriam, N. Amer. Fauna, 4:51, October 8, 1890 (type locality, sandhills on Birdwood Creek, Lincoln Co., Nebraska); Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Blossom, Occas. Papers Mus. Zool., Univ. Michigan, 368:1, April 6, 1938; Hooper, Occas. Papers Mus. Zool., Univ. Michigan, 420:3, June 28, 1940; Villa-R and Hall, Univ. Kansas Publ., Mus. Nat. Hist., 1:222 (measurements of topotypes on pp. 232-233), November 29, 1947; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:335, March 3, 1955; Russell and Jones, Trans. Kansas Acad. Sci., 58:513, January 23, 1956; Hall and Kelson, The mammals of North America, p. 449, March 31, 1959.

Geomys lutescens hylaeus Blossom, Occas. Papers Mus. Zool., Univ. Michigan, 368:1, April 6, 1938 (type locality, 10 mi. S Chadron, Dawes Co., Nebraska); Swenk, Missouri Valley Fauna, 2:9, February 1, 1940.

Geomys lutescens levisagittalis Swenk, Missouri Valley Fauna, 2:4, February 1, 1940 (type locality, Spencer, Boyd Co., Nebraska).

Geomys lutescens vinaceus Swenk, Missouri Valley Fauna, 2:7, February 1, 1940 (type locality, Scottsbluff, Scotts Bluff Co., Nebraska).

Geomys bursarius, Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:708, 1859; Hayden, Trans. Amer. Philos. Soc., 12(n.s.): 146, 1863; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 93, 1875; Coues, *in* Powell, Exploration of the Colorado River of the West and its tributaries . . ., p. 221, 1875; Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:612, August, 1877; Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880 (part); Merriam, N. Amer. Fauna, 8:120, January 31, 1895 (part); Swenk, Proc. Nebraska Acad. Sci., 8:106, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:50, September, 1908 (part); Jones, Nebraska Bird Rev., 20:10, January, 1952.

Geomys lutescens, Merriam, N. Amer. Fauna, 8:127, January 31, 1895 (part); V. Bailey, Bull. Div. Ornith. Mamm., U. S. D. A., 5:39, 1895; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:107, September, 1908 (part); Swenk Studies Zool. Lab., Univ. Nebraska, 89:51, September, 1908 (part); Lyon and Osgood, Bull. U. S. Nat. Mus., 62:71, January 28, 1909; Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 481, December, 1920; Wade, Jour. Mamm., 8:310, November 11, 1927; Beed, Bull, Conserv. Surv. Div., Univ. Nebraska, 10:26, October, 1936; Poole and Schantz, Bull. U. S. Nat. Mus., 178:369, April 9, 1942; Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Geomys bursarius hylaeus, Miller and Kellogg, Bull. U. S. Nat. Mus., 205:335, March 3, 1955; Hall and Kelson, The mammals of North America, p. 449, March 31, 1959.

Geomys bursarius levisagittalis, Miller and Kellogg, Bull. U. S. Nat. Mus., 205:335, March 3, 1955; Hall and Kelson, The mammals of North America, p. 449, March 31, 1959.

Geomys bursarius vinaceus, Miller and Kellogg, Bull. U. S. Nat. Mus., 205:335, March 3, 1955.

G[eomys]. b[ursarius]. hylaeus, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

G[eomys]. b[ursarius]. levisagittalis, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

G[eomys]. b[ursarius]. lutescens, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Western two-thirds of state, east certainly to central Antelope, Boyd, Buffalo, Franklin, and northwestern Webster counties. See Fig. 32.

External measurements.—Respective average and extreme measurements of five males and eight females from Lincoln County are: 271.8 (266-279), 241.9 (232-258); 84.4 (78-91), 73.2 (65-80); 33.8 (33-36), 31.6 (30-33); 6.0[3] (6), 5.6 (5-6). Measurements of two males, followed by average and extreme measurements of seven females, from the Pine Ridge in eastern Sioux County are: 278, 277, 252.1 (239-263); 83, 83, 73.6 (69-82); 34, 33, 31.7 (30-33); 6, 5, 5.1 (4-7). Measurements of two males and three females, respectively, from Scotts Bluff County are: 300, 269, 245, 244, 235; 86, 79, 73, 68, 68; 35, 35, 32, 32, 31; 6, 7, 6, 6, 6. Measurements of one male and three females, respectively, from the vicinity of Spencer, Boyd County, are: 280, 258, 255, 252; 77, 73, 69, 73; 37, 33, 30, 31; 6, 5, 5, 5. See Swenk (1940:9) for additional measurements and for cranial measurements see Table 11.

Three males from Lincoln County weighed in grams 288.7, 275.6, 266.0; eight females from there averaged 165.6 (148.6-178.2). Two males from eastern Sioux County weighed 285.0 and 305.0; seven females from there averaged 197.9 (170.8-225.0).

Remarks.—From *Geomys bursarius majusculus,* geographically adjacent to the east in Nebraska, *G. b. lutescens* differs conspicuously in being smaller (both externally and cranially) and paler. Specimens from the eastern edge of the range of *lutescens* (Adams, Antelope, Buffalo, Harlan, Holt, Kearney, and Webster counties, and from the tablelands to the north of the Niobrara River in Boyd and Keya Paha counties) are variously darker, and in some cases slightly larger, than typical *lutescens* and are judged to show intergradation with *majusculus.* Most of these specimens are grayer or more brownish than topotypes of *lutescens* but two from Ravenna are reddish brown. A series of nine specimens from 1 mi. SE Franklin are fairly typical of *lutescens* in both size and color. Specimens taken on the Sand Hills, including those from the type locality, average slightly paler than specimens from other parts of the range in Nebraska.

Three named kinds of pocket gophers (*Geomys lutescens hylaeus* Blossom, 1938, *Geomys lutescens levisagittalis* Swenk, 1940, *Geomys lutescens vinaceus* Swenk, 1940) are here regarded as synonyms of the earlier-named *G. b. lutescens.* One of these, *vinaceus,* was rel-

egated to synonymy under *lutescens* by Russell and Jones (1956:512-513) because a majority of the specimens of *vinaceus* examined by them did not differ significantly from topotypes of *lutescens*. Their argument was summarized (p. 513) as follows: "The differences that separate . . . *vinaceus* from . . . *lutescens* are slight and are reflected only in animals from the type locality. We interpret these slight differences as minor variations within a local population and as of no subspecific significance." The two remaining kinds, *hylaeus* and *levisagittalis*, have stood until now in the literature as valid subspecies.

The specimens upon which the name *levisagittalis* was based are intergrades between *G. b. lutescens* and *G. b. majusculus* of eastern Nebraska, although definitely assignable to the former. Swenk regarded *lutescens* and *majusculus* as belonging to different species. Consequently, he was led to propose a new name for the population of pocket gophers on the tablelands to the north of the Niobrara River in Boyd, Keya Paha, and extreme northeastern Cherry counties, individuals of which are slightly larger and somewhat darker than typical *lutescens*. Had Swenk been aware that *lutescens* and *majusculus* were conspecific he most certainly would have recognized these individuals as intergrades between the two. Specimens from the vicinity of the type locality of *levisagittalis* (Spencer, Boyd County) are, on the average, the largest and darkest of the pocket gophers from the geographic range ascribed to that race by Swenk. In both size and color, however, specimens from the vicinity of Spencer are clearly nearer *lutescens* than *majusculus*. Westward from Spencer to Valentine on the tablelands north of the Niobrara pocket gophers become progressively smaller and paler and most specimens from the vicinity of the latter locality are typical of *lutescens;* only a few are darker.

The name *hylaeus* was proposed for specimens from the Pine Ridge, 10 mi. S Chadron, that were alleged to differ from *G. b. lutescens* in being smaller and darker, especially middorsally. The five "adults" (holotype and four paratypes) that formed the basis of Blossom's (1938:1-2) description of *hylaeus* all are, instead, young adults. Actually, adult pocket gophers from localities on the Pine Ridge are approximately the same size as (if anything slightly larger than) topotypes of *lutescens* (see measurements herein and those of Swenk, 1940*a*:9-10) and do not differ from them in cranial details. Some specimens from the Pine Ridge are darker dorsally, especially middorsally, than topotypes of *lutescens* but the color of many others is within the range of variation of the latter. For

example, of nine adults from the immediate vicinity of Crawford, in extreme eastern Sioux County, five fit fairly well into a series of topotypes of *lutescens* (at best only slightly darker than the average), two are noticeably darker than the average of *lutescens,* but only two are darker than the darkest *lutescens.* The darkest of the two specimens mentioned last (NSM 12121, obtained on July 2, 1957, 6½ mi. W Crawford) resembles the holotype of *hylaeus,* which is the darkest of the specimens on which the name was based. NSM 12121 is molting; new, relatively pale pelage is present on the head and anterior part of the back. The remaining portion of the dorsal area is dark gray, quite in contrast to the sides, and seemingly caused by wear on the old pelage to the extent that most or all of the buffy subterminal band on each of the hairs has been worn away, leaving only the long, plumbeous base. Probably the hard, rough soils of the Pine Ridge cause greater wear on the pelage of gophers than do any of the other soil types within the range of *lutescens* in Nebraska; certainly they cause greater wear than does the pliable dunesand of the Sand Hills.

Pocket gophers from other localities on the Pine Ridge in Nebraska and adjacent South Dakota follow a similar pattern—that is, some, but not all, specimens are somewhat darker middorsally than *lutescens* but do not differ otherwise. Blossom (*loc. cit.*) thought a relationship existed "between the dark coloration of *hylaeus* and the dark, humus filled soil of its woodland habitat." Undoubtedly this is partly true, but the soils of the Pine Ridge are not especially darker in most places than those to the south of the Ridge. The Pine Ridge itself is relatively narrow, less than 10 miles wide in many places, and *Geomys bursarius* seemingly occurs only sparingly immediately to the north where *Thomomys talpoides pierreicolus* is found. The slightly darker color of pocket gophers on the Pine Ridge is continually diluted through complete intergradation with paler pocket gophers to the south, preventing the establishment of a stable genetic composition in the population. I am aware that a less conservative taxonomist might recognize *hylaeus* as a "weak" subspecies; I was tempted to do so myself at one stage. All things considered, however, I cannot, on the basis of the material now available, conscientiously admit its validity.

Records of occurrence.—Specimens examined, 369, as follows: ANTELOPE COUNTY: Neligh, 5 (2 NSM, 3 USNM); *1 mi. SW Neligh,* 3. BANNER COUNTY: 9 mi. N, 5 mi. E Harrisburg, 1; SE of Hubbard Gap, 1 (NSM); Bull Canyon, 1 (NSM). BOYD COUNTY: 1 mi. S Butte, 1; *5 mi. WNW Spencer,* 1; *1 mi. WNW Spencer,* 5; Spencer, 2 (NSM). BOX BUTTE COUNTY: Hemingford, 2 (NSM). BUFFALO COUNTY: Ravenna, 2 (UMMZ); *Kearney,* 1 (USNM). CHERRY COUNTY: Valentine, 11 (1 NSM, 2 UMMZ, 2 UNDZ,

6 USNM); *Ft. Niobrara Nat'l Wildlife Refuge, 4 mi. E Valentine,* 10 (5 NSM, 3 USNM); *Snake River,* 1 (USNM); 18 mi. NW Kennedy, 2 (USNM); *1 mi. W Headquarters, Valentine Nat'l Wildlife Refuge,* 1 (UC); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 7 (2 UMMZ); Kennedy, 13 (1 MVZ, 12 USNM); Brownlee, 1 (USNM); North Fork, Middle Loup River, NW of Mullen, 2 (NSM); *no specific locality* (7 from Clark's Canyon, near Valentine, according to Merriam, 1895:129), 8 (USNM). CHEYENNE COUNTY: 2 mi. N Dalton, 4300 ft., 1; *Dalton,* 1 (NSM); 15 mi. S Dalton, 4300 ft., 11; *1 mi. S, 2 mi. E Bronson,* 1; *3 mi. N Sidney, 4250-4300 ft.,* 2; *1.4 mi. NE Sidney, 4200 ft.,* 1; *Sidney,* 4 (3 NSM, 1 USNM); Lodgepole, 1 (NSM). CUSTER COUNTY: Victoria Springs, 3 (UMMZ); Callaway, 4 (USNM). DAWES COUNTY: Chadron, 3360 ft., 4 (2 CSTC, 1 NSM, 1 USNM); *6 mi. S Chadron,* 1; *8 mi. S Chadron,* 1 (NSM); *9 mi. S Chadron,* 1; 10 mi. S Chadron, 14 (11 UMMZ); Crawford, 2 (1 NSM, 1 USNM); *Ft. Robinson,* 1 (USNM); *no specific locality,* 1 (AMNH). DAWSON COUNTY: Lexington, 2 (NSM). DEUEL COUNTY: Chappell, 1 (NSM). DUNDY COUNTY: Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, 8 (1 NGFPC); 2 mi. SW Benkelman, 1; Haigler, 2 (NSM). FRANKLIN COUNTY: 1 mi. SE Franklin, 9. FRONTIER COUNTY: 4 mi. N Curtis, 1 (UC). GARDEN COUNTY: no specific locality, 6. HARLAN COUNTY: 1 mi. S Alma, 1. HITCHCOCK COUNTY: Trenton, 2. HOLT COUNTY: 6 mi. N Midway, 7; Ewing, 2 (USNM). KEARNEY COUNTY: 3¾ mi. S Kearney, 3. KEITH COUNTY: 4 mi. NNW Keystone, 1; Ogallala, 1 (NSM); *no specific locality,* 1 (NSM). KEYA PAHA COUNTY: 10-12 mi. N Springview, 7. KIMBALL COUNTY: Kimball, 4 (NSM). LINCOLN COUNTY: Myrtle, 2 (USNM); *Birdwood Creek,* 1 (USNM), the holotype; Birdwood Creek, 7-8 mi. N, 4 mi. W Hershey, 2950 ft., 32; *8 mi. N, 3 mi. W Hershey,* 4; 2 mi. N North Platte, 1; *forks of the Platte River,* 1 (USNM); Conroy Canyon, sec. 9, T. 11 N, R. 27 W (5 mi. S, 2½ mi. W Brady), 4 (NSM); *no specific locality,* 6 (1 NSM, 5 USNM). MORRILL COUNTY: 12-15 mi. N Bridgeport, 16 (NSM); Bridgeport, 6 (NSM); Redington Gap (2 mi. N Redington), 4 (NSM). ROCK COUNTY: 1 mi. E Bassett, 1 (CNHM). SCOTTS BLUFF COUNTY: 8 mi. NNW Scottsbluff, 1; *1 mi. W Scottsbluff, 3900 ft.,* 1; Scottsbluff, 3900 ft., 14 (2 AMNH, 3 HM, 7 NSM); *1 mi. E Scottsbluff, 3900 ft.,* 1; *2 mi. S, 1 mi. W Scottsbluff, 3900 ft.,* 8; *11-12 mi. S Scottsbluff, 4600 ft.,* 5. SHERIDAN COUNTY: *Niobrara River,* 1 (USNM); 18 mi. S Hay Springs, 2 (WSC); *Mirage Twp.,* 3 (UMMZ); 16 mi. NE Alliance, 2 (UMMZ); 4 mi. N Antioch, 11 (UMMZ); NW side Snow Valley, N of Lakeside, 1 (NSM). SIOUX COUNTY: Warbonnet Canyon, 1 (NSM); Plunkett's Ranch, 10 mi. NE Harrison, 3 (NSM); *8 mi. N Harrison,* 1 (UMMZ); Harrison, 3 (2 NSM, 1 USNM); *6½ mi. W Crawford,* 8 (NSM); *1 mi. S, 4 mi. W Crawford,* 5 (NSM); Glen, 1 (NSM); Agate, 3 (UMMZ); *3 mi. E Agate,* 1; *Running Water Creek, E of Agate,* 1 (CM). THOMAS COUNTY: Halsey, 9 (USNM); *1 mi. S, 3½ mi. W Halsey,* 1; *Nebraska Nat'l Forest,* 3 (NGFPC); *Dismal River,* 1 (USNM). WEBSTER COUNTY: Bladen, 1 (HM). County unknown: *Loup Fork,* 3 (USNM); *Platte River,* 1 (USNM); *South Platte River,* 1 (USNM).

Additional records: CHERRY COUNTY: *Center Lake* and North Marsh Lake, Valentine Nat'l Wildlife Refuge (Jones, 1952:10). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272); Ash Hollow, 3 mi. SE Lewellen (Champe, 1946:44, archeological site). HOOKER COUNTY: no specific locality (Fichter, 1941:28). LINCOLN COUNTY: *North Platte* (Wade, 1927*b*:310). RED WILLOW COUNTY: 9 mi. NE Bartley (Jones, 1949*b*:5). SIOUX COUNTY: Orella (Jones, 1949*b*:5). THOMAS COUNTY: Seneca (Swenk, MS). WHEELER COUNTY: Ericson (Merriam, 1895:120). See also Swenk (1940*a*:2-9).

Geomys bursarius majusculus Swenk

Geomys bursarius majusculus Swenk, Missouri Valley Fauna, 1:6, December 5, 1939 (type locality, Lincoln, Lancaster Co., Nebraska); Villa-R and Hall, Univ. Kansas Publ., Mus. Nat. Hist., 1:223 (topotypes mentioned on p. 225), November 29, 1947; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:334, March 3, 1955; Hall and Kelson, The mammals of North America, p. 450, March 31, 1959.

Pseudostoma bursaria, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Geomys bursarius, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880 (part); Merriam, N. Amer. Fauna, 8:120, January 31, 1895 (part); V. Bailey, Bull. Div. Ornith. Mamm., U. S. D. A., 5:33, 1895; Swenk, Proc. Nebraska Acad. Sci., 8:106, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:50, September, 1908 (part); Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Wade and Gilbert, Amer. Midland Nat., 16:960, 1935; Whelan, Trans. Kansas Acad. Sci., 39:365, 1937.

Geomys lutescens, Merriam, N. Amer. Fauna, 8:127, January 31, 1895 (part); Swenk, Proc. Nebraska Acad. Sci., 8:107, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:51, September, 1908 (part).

G[eomys]. b[ursarius]. majusculus, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Eastern third of state, west certainly to Adams, Antelope, and Knox counties. See Fig. 32.

External measurements.—Average and extreme measurements of 48 male and 50 female topotypes (after Swenk, 1939:3) are, respectively: 319.6 (294-352), 290.2 (278-316); 95.2 (75-107), 88.6 (77-102); 38.7 (36-43), 35.4 (33-39). The length of ear of three male topotypes measured 7, 8 and 9. For cranial measurements see Table 11.

Weight in grams of three male topotypes was 415.5, 417.0 and 402.5; that of a male and female from 2 mi. S and ½ mi. E Barnston, respectively, 411.0 and 271.0; that of a female from 5 mi. W Tilden, 316.8.

Remarks.—*G. b. majusculus* is so much larger, both externally and cranially, and so much darker than *Geomys bursarius lutescens* that it is easy to understand why Merriam (1895), Swenk (1939, 1940*a*, and elsewhere), and others, lacking certain evidence of intergradation, regarded the two as distinct species.

The area of intergradation between *lutescens* and *majusculus* is relatively narrow in most areas to the north of the Platte River. In Antelope County, for example, nearly typical (slightly darker) specimens of *lutescens* have been taken in the vicinity of Neligh, whereas two specimens from Oakdale, only five miles to the southeast, are clearly assignable to *majusculus* (although slightly smaller than topotypes), as is a specimen from 5 mi. W Tilden. *G. b. majusculus* occurs also in western Knox county but pocket gophers from the tableland in central Boyd County, less than 35 miles westward, are clearly *G. b. lutescens,* although somewhat darker and slightly larger than topotypes of the latter.

To the south of the Platte River intergradation between the two subspecies is evident in five specimens from Hastings. All five are relatively dark, but slightly more reddish than typical *majusculus,* to which subspecies they are herein assigned, whereas in size the five are, if anything, nearer *lutescens.*

TABLE 11.—CRANIAL MEASUREMENTS OF THOMOMYS AND GEOMYS.

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Mastoid breadth	Breadth of rostrum	Length of maxillary tooth-row	Depth of skull
Thomomys talpoides cheyennensis, Smeed, Kimball County							
76922 KU, ♀	39.5	23.8	6.5	19.9	8.0	7.8	16.0
Thomomys talpoides pierreicolus, topotypes							
15136 KU, ♂	36.8	23.1	6.4	19.4	7.5	7.1	14.9
15139 KU, ♀	35.7	22.5	6.5	19.5	7.2	7.2	14.3
15142 KU, ♀	36.0	23.8	6.0	19.5	7.3	7.1	14.2
15143 KU, ♀	34.6	21.9	6.6	18.0	7.3	7.2	13.8
Geomys bursarius lutescens, vicinity Spencer, Boyd County							
77960 KU, ♂	50.9	34.6	6.8	29.3	12.7	9.2	22.3
77959 KU, ♀	44.0	27.5	7.0	25.4	10.3	9.0	17.8
77961 KU, ♀	.....	28.6	6.9	25.7	11.0	9.2	18.1
77962 KU, ♀	43.1	28.0	6.3	25.4	10.4	8.4	18.0
Birdwood Creek, NW of Hershey, Lincoln County							
15215 KU, ♂	48.3	31.1	6.7	26.8	11.8	9.1	19.7
15242 KU, ♂	48.6	31.5	6.7	27.3	11.9	9.4	20.1
15224 KU, ♀	43.5	26.3	6.1	23.9	10.4	8.4	16.9
15234 KU, ♀	43.5	25.9	6.4	24.5	10.6	9.0	17.1
Scotts Bluff County							
15182 KU, ♂	51.2	32.8	7.0	29.5	13.5	8.6	22.2
15189 KU, ♂	48.8	29.9	7.0	26.2	11.6	8.4	19.6
15179 KU, ♀	41.6	26.1	6.1	24.0	10.1	8.1	17.5
15183 KU, ♀	42.3	25.9	6.3	23.8	10.5	8.6	16.6
15195 KU, ♀	41.8	25.2	6.5	23.8	9.7	8.0	16.5
vicinity Crawford, in Sioux County							
12119 NSM, ♂	48.5	31.4	7.2	28.2	12.2	9.7	20.8
12121 NSM, ♂	46.9	29.6	7.1	27.2	12.5	9.3	18.7
Average 7 (♀)	42.9	26.6	6.7	24.6[6]	10.6	8.5	17.3
Minimum	42.2	25.8	6.3	23.9	10.3	8.2	16.9
Maximum	43.8	27.0	7.0	26.0	10.8	8.8	17.8
Geomys bursarius majusculus, Lincoln, Lancaster County							
Average 7 (♂)	58.7	36.4	7.2	33.6	12.7	9.9	23.4[6]
Minimum	56.9	35.1	6.7	31.8	12.0	9.2	22.9
Maximum	61.5	38.9	7.5	36.4	14.7	10.5	24.6
4005 NSM, ♀	50.4	29.6	6.6	27.9	11.3	9.6	19.8
4009 NSM, ♀	49.4	30.1	7.1	28.4	11.1	8.6	19.8
15247 KU, ♀	51.8	31.5	6.9	30.6	12.3	9.3	20.2

Topotypes of *G. b. majusculus* do not differ in color from specimens that I have seen of *G. b. bursarius* from Elk River, Sherburne County, Minnesota, the restricted type locality of the latter (Swenk, 1939:6). However, specimens of *majusculus* average distinctly larger than those of *bursarius* and this, coupled with the fact that smaller pocket gophers occur on all sides of the range of *majusculus*, warrants subspecific recognition for it.

Records of occurrence.—Specimens examined, 118, as follows: ADAMS COUNTY: Hastings, 5 (4 AMNH, 1 HM); *no specific locality*, 1 (HM). ANTELOPE COUNTY: Oakdale, 2 (USNM); *5 mi. W Tilden*, 1. BUTLER COUNTY: 4-5 mi. E Rising City, 4. CASS COUNTY: Wabash, 1 (NSM). CLAY COUNTY: Inland, 2 (HM). CUMING COUNTY: West Point, 1 (WFR). DODGE COUNTY: Ames, 1 (USNM). DOUGLAS COUNTY: 8240 Keystone Drive, Omaha, 2. GAGE COUNTY: Liberty, 1 (NSM); 2 mi. S, ½ mi. E Barnston, 3. KNOX COUNTY: mouth of Niobrara River, 2 (USNM); Verdigre, 1 (USNM). LANCASTER COUNTY: Malcolm (T. 10 N, R. 5 E), 1 (NSM); *1 mi. N Lincoln*, 1 (NSM); *¼ mi. N Lincoln*, 4 (NSM); Lincoln, 43 (2 AMNH, 3 MVZ, 19 NSM, 7 UC, 6 UNDZ, 2 USNM), including the holotype; *5¾ mi. E Lincoln*, 9; *½ mi. S College View, Lincoln*, 2; *4 mi. SE Lincoln*, 1 (UNDZ); *5½ mi. S, 3 mi. E Lincoln*, 1 (UC); *8 mi. S, 4 mi. E Lincoln*, 3 (UC); Roca, 1 (CNHM); *no specific locality*, 1 (NGFPC). MADISON COUNTY: Norfolk, 3 (USNM). NEMAHA COUNTY: 1 mi. S Peru, 1. OTOE COUNTY: 4 mi. W Dunbar, 1 (NGFPC); *1 mi. SE Nebraska City*, 1; 3 mi. S, 2 mi. E Nebraska City, 1. PLATTE COUNTY: Columbus, 1 (USNM). RICHARDSON COUNTY: 4 mi. E Barada, 2. SARPY COUNTY: Ft. Crook, 12 (AMNH). WASHINGTON COUNTY: Blair, 1 (USNM); *1 mi. E Blair*, 1.

Additional records: CLAY COUNTY: Trumbull (Swenk, MS). COLFAX COUNTY: Schuyler (Gates, 1945:11). DOUGLAS COUNTY: *near Irvington* (Haecker, 1941:10). GAGE COUNTY: Beatrice (Swenk, 1908:106). LANCASTER COUNTY: *9 mi. NW Lincoln* (Whelan, 1937:365). NEMAHA COUNTY: London (V. Bailey, 1895:36). OTOE COUNTY: *Turlington* (V. Bailey, 1895: 35); *J. Sterling Morton's home [Nebraska City]* (V. Bailey, 1895:34). SALINE COUNTY: Crete (Swenk, 1908:106). WASHINGTON COUNTY: Herman (Gates, 1945:11); Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369).

Family HETEROMYIDAE—Pocket Mice and Kangaroo Rats

KEY TO NEBRASKAN HETEROMYIDS

1. Hind foot more than 35; breadth across mastoids more than 22. *Dipodomys ordii*, p. 178
1′. Hind foot less than 30; breadth across mastoids less than 18.....2
2(1′). Total length more than 150; occipitonasal length more than 25; pelage harsh.....*Perognathus hispidus*, p. 173
2′. Total length less than 150; occipitonasal length less than 25; pelage soft.....3
3(2′). Postauricular patch conspicuous, larger than ear; breadth of interparietal less than 4.1, interparietal not nearly so broad as interorbital region.....*Perognathus flavus*, p. 171
3′. Postauricular patch often inconspicuous, usually smaller than ear; breadth of interparietal more than 4.1, approximately the same as breadth of interorbital region.....4
4(3′). Tympanic bullae not meeting anteriorly; dorsal pelage olivaceous. *Perognathus fasciatus*, p. 164
4′. Tympanic bullae usually meeting anteriorly; dorsal pelage buffy or brownish.....*Perognathus flavescens*, p. 167

Perognathus fasciatus

Olive-backed Pocket Mouse

Perognathus fasciatus inhabits the High Plains of the Panhandle of Nebraska and the Crookston Table, a flat, elevated tableland north of the Niobrara River in northeastern Cherry County and adjacent Keya Paha County. Evidently it does not occur on the Sand Hills, where the closely related *Perognathus flavescens* is a common inhabitant. *P. fasciatus* is the only species of the subgenus *Perognathus* that has been taken on the Pine Ridge, where T. A. Vaughan and I found it not uncommon in the summer of 1957. Specimens were trapped on dry hillsides that supported yucca, sparse grasses, and occasionally ponderosa pine; frequently these hillsides also had scattered, rocky outcroppings.

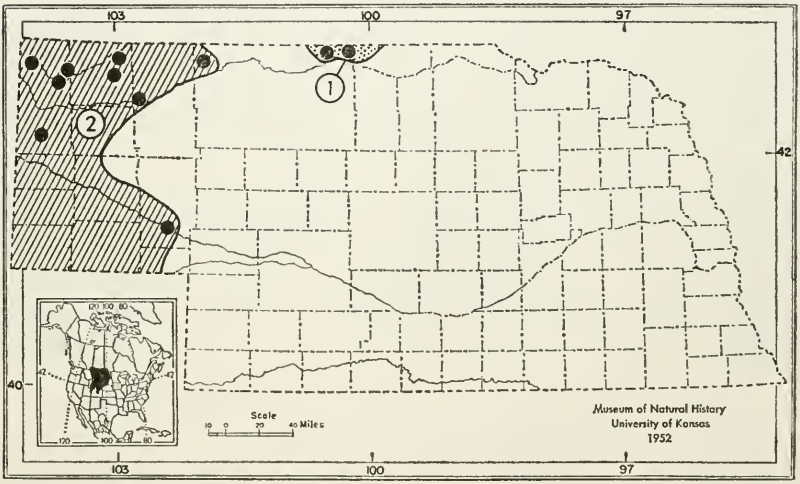

FIG. 33. Distribution of *Perognathus fasciatus* in Nebraska. 1. *P. f. fasciatus.* 2. *P. f. olivaceogriseus.* For explanation of symbols see Fig. 5.

The geographic range of *P. fasciatus* overlaps that of *P. flavescens* in Nebraska in the southern part of the Panhandle and on the Crookston Table but the two species have been taken together only at the latter place and at a place 2 mi. S Oshkosh. *P. fasciatus* averages larger than *P. flavescens* (both externally and cranially), has a darker (olivaceous rather than buffy) dorsum, darker dorsal surface of tail, and paler lateral line. The skulls of the two species are similar but differ in the construction of the tympanic bullae. In *fasciatus* the bullae do not meet anteriorly over the basisphenoid, but in *flavescens* the anterointernal margin of each bulla is some-

what fan-shaped and the bullae usually meet over the basisphenoid. Other cranial differences, not entirely consistent, that help to differentiate *fasciatus* from *flavescens* in Nebraska upon direct comparison are: nasals broader and more truncate posteriorly, each nasal broader than adjacent arm of premaxilla at approximate level of middle of maxillary arm of zygomatic arch; extension of frontal along margin of maxilla shorter; maxillary arm of zygoma stouter, especially proximally; interparietal relatively narrow, not conspicuously emarginate at middle of posterior margin; infraorbital foramen larger; mastoid bullae larger; tympanic bullae more inflated; p1 larger, approximately half the size of m1 and nearly as large as m3; mandibular process larger.

Asdell (1946:230) reported that females bear 4-6 young per litter. A female from 5½ mi. W Crawford, trapped on July 28, 1957, had six placental scars but was no longer lactating.

Perognathus fasciatus fasciatus Wied-Neuwied

Perognathus fasciatus Wied-Neuwied, Nova Acta Phys.-Med. Acad. Caesar. Leop.-Carol., 19:369, 1839 (type locality, Upper Missouri River, near its junction with the Yellowstone River, near the present town of Buford, Williams Co., North Dakota).

Perognathus fasciatus fasciatus, Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:519, August 1, 1953; Hall and Kelson, The mammals of North America, p. 475, March 31, 1959.

P[erognathus]. f[asciatus]. fasciatus, Jones, Trans. Kansas Acad. Sci., 60:276, October 22, 1957.

Distribution in Nebraska.—Known only from northeastern Cherry County; probably occurring also in adjacent Keya Paha County. See Fig. 33.

External measurements.—Measurements of a female from Sparks are: 132; 60; 17.3; 6.5. For cranial measurements of this same specimen see Table 12.

Remarks.—From *Perognathus fasciatus olivaceogriseus* of the Nebraskan Panhandle, *P. f. fasciatus* differs in being darker dorsally, especially on the face, which is distinctly less yellowish. Nebraskan specimens of *P. f. fasciatus* are not so dark as specimens of that subspecies from central North Dakota but are slightly darker than topotypes.

Records of occurrence.—Specimens examined, 4, as follows: CHERRY COUNTY: Sparks, 1 (UMMZ); Valentine, 2 (UNDZ); *Ft. Niobrara Nat'l Wildlife Refuge,* 1 (NSM).

Perognathus fasciatus olivaceogriseus Swenk

Perognathus flavescens olivaceogriseus Swenk, Missouri Valley Fauna, 3:6, June 5, 1940 (type locality, Little Bordeaux Creek, 3 mi. E Chadron, Dawes Co., Nebraska); Miller and Kellogg, Bull. U. S. Nat. Mus., 205: 355, March 3, 1955.

Perognathus fasciatus olivaceogriseus, Jones, Univ. Kansas Publ., Mus. Nat. Hist., 5:520, August 1, 1953; Hall and Kelson, The mammals of North America, p. 476, March 31, 1959.

Perognathus flavescens(?), Cary, Proc. Nebraska Ornith. Union, 3:68-69, December, 1902.

Perognathus fasciatus, Swenk, Proc. Nebraska Acad. Sci., 8:110, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:54, September, 1908.

Perognathus fasciatus fasciatus, Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

P[erognathus]. f[asciatus]. olivaceogriseus, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—High Plains of Panhandle, east certainly to Garden County and extreme western Cherry County. See Fig. 33.

External measurements.—Measurements of the holotype, followed by average and extreme measurements of 13 specimens (eight males, five females) from Sioux and Dawes counties, are: 125, 131.9 (124-141); 58, 61.1 (57-68); 16.5, 17.3 (16-18); 6.5, 7.0 (6.5-8). For cranial measurements see Table 12. The average weight in grams of 10 specimens from eastern Sioux County (six males, four females) was 11.4 (10.0-13.4).

Remarks.—For comparison with *Perognathus fasciatus fasciatus* of northeastern Cherry County, see account of that subspecies. Nebraskan specimens of *fasciatus* and *olivaceogriseus* do not differ in cranial details.

The geographic ranges of the subspecies *olivaceogriseus* and *fasciatus* do not meet in Nebraska, but are separated by a part of the Sand Hills, approximately 60 miles wide, that extends north to the South Dakota border in Cherry County. Significantly, the easternmost record of occurrence of *olivaceogriseus* is in northwestern Cherry County at a place where soils of the Rosebud series, which are similar to soils on the Crookston Table, intrude from the west, making a wedge into the Sand Hills just north of the Niobrara River.

Swenk (1940*b*:6) mistakenly named *olivaceogriseus* as a subspecies of *P. flavescens* (see Jones, 1953:520-521). Fortuitously, therefore, the type locality was poorly chosen for a race of *P. fasciatus,* because now the type localities of the subspecies *fasciatus* and *olivaceogriseus* both lie in the fairly broad zone of intergradation between the distinctive populations that bear the respective names. Ideally, the type locality of *fasciatus* should be in central North Dakota and that of *olivaceogriseus* in northeastern Wyoming.

The specimen from 2 mi. S Oshkosh (KU 76929), a young adult, is unusually small, and the pale yellowish of the lateral line encroaches on the flanks and a part of the venter. Perhaps this specimen indicates intergradation in the southwestern part of the Panhandle between *P. f. olivaceogriseus* and *P. f. infraluteus* (type locality, Loveland, Larimer County, Colorado). It is provisionally referred to *olivaceogriseus.*

Records of occurrence.—Specimens examined, 29, as follows: CHERRY COUNTY: 10 mi. E Gordon, 1 (CNHM); *12 mi. ESE Gordon*, 2 (CNHM). DAWES COUNTY: Little Bordeaux Creek, 3 mi. E Chadron, 1 (MVZ), the holotype; *1 mi. SW Chadron*, 1 (NSM); 10 mi. S Chadron, 3 (UMMZ); *Chadron State Park*, 1 (NGFPC). GARDEN COUNTY: 2 mi. W Oshkosh, 1. SHERIDAN COUNTY: Mirage Twp., 1 (UMMZ). SIOUX COUNTY: Monroe Canyon, 1 (NGFPC); 5½-6 mi. W Crawford, 9 (8 NSM); *3½ mi. N, 1 mi. E Glen*, 3 (NSM); *3 mi. N Glen*, 3 (NSM); Glen, 1 (NSM); ½ mi. E, 16 mi. S Agate, 4950 ft., 1.

Perognathus flavescens

Plains Pocket Mouse

The plains pocket mouse is nearly state-wide in distribution, being absent only from the Pine Ridge area of extreme northwestern Nebraska and from the southeastern part of the state. Actually, the species may have occurred formerly in much of the southeastern part, prior to the breaking of the prairie for cultivation, because it is known as far south on the eastern side of the Missouri River as

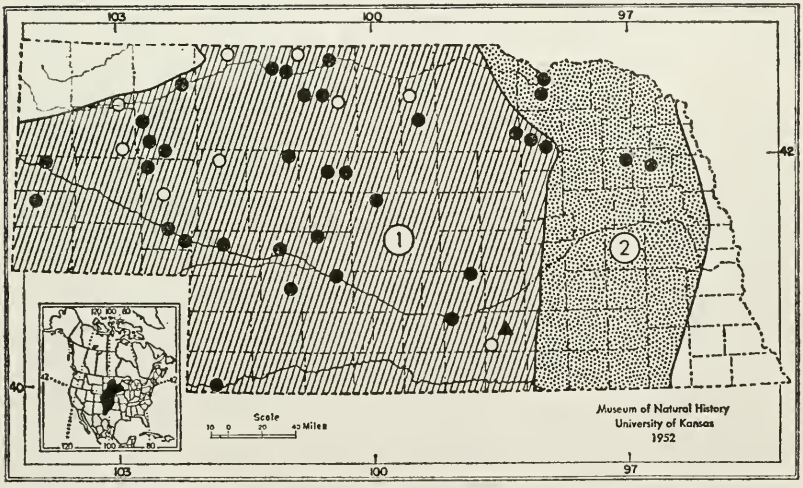

FIG. 34. Distribution of *Perognathus flavescens* in Nebraska. 1. *P. f. flavescens.* 2. *P. f. perniger.* For explanation of symbols see Fig. 5.

Randolph, Fremont County, Iowa (see Hall and Kelson, 1959: 477). Individuals may yet be taken in the southeast in some of the isolated patches of original prairie that still exist there; I have unsuccessfully trapped for *P. flavescens* in just such places in Jefferson, Pawnee, and Lancaster counties.

The species is most abundant in Nebraska on the Sand Hills, where it is one of the commonest small mammals. On the High Plains *P. flavescens* occurs all the way to the Wyoming border, but

is nowhere so abundant as on the Sand Hills and most often is taken in relatively sandy areas.

Like other Nebraskan species of the genus, *P. flavescens* is difficult to trap in summer and autumn, seemingly because individuals prefer the seeds of native weeds and grasses to conventional baits such as oatmeal. Members of the species are inactive during the colder parts of winter, when snow covers the ground, but are not known certainly to hibernate.

Three Nebraska-taken females, one in May and two in July, carried 2, 4, and 5 embryos. A lactating female was taken on July 30, 1952.

Perognathus flavescens flavescens Merriam

Perognathus fasciatus flavescens Merriam, N. Amer. Fauna, 1:11, October 25, 1889 (type locality, Kennedy, Cherry Co., Nebraska); J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:247, November 25, 1896.

Perognathus flavescens, Osgood, N. Amer. Fauna, 18:20, September 20, 1900 (part); Swenk, Proc. Nebraska Acad. Sci., 8:110, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:54, September, 1908 (part); Jones, Nebraska Bird Rev., 20:10, January, 1952.

Perognathus flavus, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1): 423, July 14, 1858; Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:709, 1859; Hayden, Trans. Amer. Philos. Soc., 12(n.s.):147, 1863; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 93, 1875.

Cricetodipus flavus, Coues, Proc. Acad. Nat. Sci. Philadelphia, p. 300, August 31, 1875; Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:516, August, 1877; Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Perognathus fasciatus, Elliot, Field Columb. Mus., Zool. Ser. (Publ. 115), 8:331, 1907.

Perognathus flavescens flavescens, Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Swenk, Missouri Valley Fauna, 3:1, June 5, 1940; Poole and Schantz, Bull. U. S. Nat. Mus., 178:428, April 9, 1942; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:483, April 21, 1954; Hall and Kelson, The mammals of North America, p. 476, March 31, 1959.

Perognathus f[lavescens]. flavescens, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

P[erognathus]. f[lavescens]. flavescens, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Western part of state, excepting extreme northwestern part, east certainly to Adams and Antelope counties. See Fig. 34.

External measurements.—Average and extreme measurements of 10 specimens (three males, seven females) from the vicinity of the type locality are: 121.5 (114-128); 59.9 (52-65); 16.8 (16-17); 6.5 (6-7). Measurements of the largest specimen of the subspecies that I have seen, a male from Hackberry Lake, are: 134; 65; 17.8; 6.7. For cranial measurements see Table 12.

A male and female from 11 mi. S Gordon weighed 10.8 and 11.0 grams, respectively. The weight of six spring-taken males from 3¾ mi. S Kearney averaged 9.6 (7.0-11.6) grams.

Remarks.—From *Perognathus flavescens perniger,* geographically adjacent to the east in Nebraska, *P. f. flavescens* differs in: upper parts distinctly paler (pale ochraceous-buff finely lined with black rather than ochraceous-buff heavily suffused with black); lateral line and dorsal surface of tail paler; postauricular patch larger and paler; external and cranial dimensions averaging slightly, perhaps not significantly, smaller.

Specimens from the eastern part of the range of *P. f. flavescens* in Nebraska (Adams, Antelope, Buffalo, and Rock counties) average darker on dorsum, tail, and lateral line than do other specimens of the subspecies and indicate intergradation with *P. f. perniger.* Three of seven specimens from Kelso are unusually dark dorsally. In addition, the color of the lateral line of each is paler than in typical specimens of *flavescens* and in two of the three encroaches on the posterior parts of the venter. These specimens resemble *perniger* to some extent in color of upper parts, but are drabber over-all than individuals of that subspecies.

Early workers, Baird (1858), Coues (1875), and Coues (*in* Coues and Allen, 1877) for example, confused under the specific name *flavus* at least the species *fasciatus, flavescens,* and *flavus,* while mistakenly employing the specific name *fasciatus* for the distinctive *Perognathus hispidus.* Not until Merriam's "Revision of the North American pocket mice," published in 1889, were the correct specific names, as currently understood, applied to the pocket mice that occur in Nebraska. I have examined most of the specimens from Nebraska listed under the name *flavus* (either as *Perognathus flavus* or *Cricetodipus flavus*) prior to 1889 and all that I have seen are *P. f. flavescens.* The recorded measurements and geographic origin of the remaining specimens indicate that they also are *P. f. flavescens.*

The specimen (USNM 3050) listed beyond from "Pole Creek, 490 mi. from Ft. Riley" may have originated from along Lodgepole Creek in extreme southeastern Wyoming rather than from the southern part of the Panhandle. Osgood (1900:21) erred in listing that specimen as from "40 miles from Fort Riley."

Records of occurrence.—Specimens examined, 181, as follows: ADAMS COUNTY: no specific locality, 1 (HM). ANTELOPE COUNTY: Clearwater, 1 (UMMZ); Neligh, 17 (1 MVZ, 1 NSM, 15 USNM); *1 mi. SW Neligh,* 1. BANNER COUNTY: 7½ mi. N, 1 mi. E Harrisburg, 1. BUFFALO COUNTY: 1 mi.

E Ravenna, 6 (UMMZ). CHERRY COUNTY: Valentine, 2 (UNDZ); *4 mi. E Valentine*, 1; Niobrara River, 10 mi. S Cody, 1 (NSM); 11 mi. S, 2 mi. W Nenzel, 1; *18 mi. NW Kennedy*, 4 (1 NSM, 3 USNM); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 21 (18 UMMZ); 2 mi. W to 4 mi. E Kennedy, 19 (4 MVZ, 1 UMMZ, 7 USNM, including the holotype; *Dewey Lake, Valentine Nat'l Wildlife Refuge*, 1; *Pelican Lake to 1 mi. W thereof, Valentine Nat'l Wildlife Refuge*, 2 (1 NGFPC, 1 UC); *4 mi. S Kennedy*, 1 (NSM); *Seaman's Lake* (not exactly located), 1 (USNM); *no specific locality*, 9 (USNM). CUSTER COUNTY: 1-4 mi. NW Gavin, 10 (UMMZ); *7-8 mi. NW Anselmo*, 5 (UMMZ). DUNDY COUNTY: 1 mi. S Parks, 1. GARDEN COUNTY: 10 mi. S Antioch, 1 (UMMZ); 2 mi. S Oshkosh, 1; Windlass Hill (2 mi. SE Lewellen), 2; *no specific locality*, 1. HOLT COUNTY: Ewing, 1 (USNM). HOOKER COUNTY: Kelso, 7 (UMMZ). KEARNEY COUNTY: 3¾ mi. S Kearney, 6. KEITH COUNTY: N side Kingsley Reservoir, 1 (NGFPC). LINCOLN COUNTY: Myrtle, 2 (USNM); Birdwood Creek, 8 mi. N, 4 mi. W Hershey, 2950 ft., 1; 1 mi. N Brady, 2 (NSM); 6 mi. NE Dickens, 3 (UMMZ); *no specific locality*, 1 (USNM). ROCK COUNTY: Perch, 10 (9 AMNH, 1 CNHM). SCOTTS BLUFF COUNTY: 8 mi. NNW Scottsbluff, 2. SHERIDAN COUNTY: 11 mi. S Gordon, 2; 16 mi. NE Alliance, 7 (UMMZ); 4-8 mi. N Antioch, 3 (UMMZ); *4 mi. W Lakeside*, 1 (MVZ); Lakeside, 1 (USNM). THOMAS COUNTY: 10 mi. W Halsey, 2 (UMMZ); *1-4 mi. W Halsey*, 4; Halsey, 2 (1 AMNH, 1 USNM); *1 mi. S, 3½ mi. W Halsey*, 1; *Dismal River turnoff, Nebraska Nat'l Forest*, 1 (NGFPC); *Nebraska Nat'l Forest*, 1 (NGFPC); *no specific locality*, 5 (USNM). County unknown: *Loup Fork*, 3 (USNM); *"Pole [Lodgepole] Creek, 490 mi. from Ft. Riley,"* 1 (USNM).

Additional records (Swenk, 1940*b*:4, unless otherwise noted): ADAMS COUNTY: Logan Twp. BOX BUTTE COUNTY: Alliance (Cary, MS). CHERRY COUNTY: Kilgore; Merriman; *Center Lake* and North Marsh Lake, Valentine Nat'l Wildlife Refuge (Jones, 1952:10-11). DAWES COUNTY: Dunlap. DUNDY COUNTY: *Ree [Arikaree] Fork* (Coues, *in* Coues and Allen, 1877: 518). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945: 272). GRANT COUNTY: Hyannis. ROCK COUNTY: Bassett (J. A. Allen, 1896:247). County unknown: *Republican Fork [River]* (Coues, *in* Coues and Allen, 1877:518).

Perognathus flavescens perniger Osgood

Perognathus flavescens perniger Osgood, Proc. Biol. Soc. Washington, 17:127, June 9, 1904 (type locality, Vermillion, Clay Co., South Dakota); Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Fichter, Jour. Mamm., 30:377, August 4, 1939; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:483, April 21, 1954; Hall, Univ. Kansas Publ., Mus. Nat. Hist., 7:589, November 15, 1954; Hall and Kelson, The mammals of North America, p. 476, March 31, 1959.

Perognathus flavescens, Osgood, N. Amer. Fauna, 18:20, September 20, 1900 (part); Swenk, Proc. Nebraska Acad. Sci., 8:110, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:54, September, 1908 (part).

P[erognathus]. f[lavescens]. perniger, Swenk, Missouri Valley Fauna, 3:4, June 5, 1940; Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Known only from northeastern part; possibly in other parts of eastern Nebraska. See Fig. 34.

External measurements.—Measurements of two males, followed by three females, from northeastern Nebraska are: 134, 129, 129, 130, 131; 62, 64, 59, 60, 65; 17, 17, 17, 17.5, 17.5; 7, 7, 6 (males and one female only). For cranial measurements see Table 12.

Remarks.—For comparison with *Perognathus flavescens flavescens*, geographically adjacent to the west in Nebraska, see account of that subspecies.

The three specimens from Beemer are typical *perniger*. All other specimens herein assigned to that subspecies are slightly paler than typical specimens and thereby intergrades with *flavescens*.

P. f. perniger was originally described (Osgood, 1904:127) on the basis of its dark upper parts, and the encroachment of the ochraceous-buff color of the lateral line onto the posterior parts of the venter. Among Nebraskan specimens, only those from Knox County have buffy underparts. None of nine specimens of *perniger* from Elk River, Sherburne County, Minnesota (KU 46526-34), has buffy underparts, but a specimen from Randolph, Fremont County, Iowa (NSM 1), does. In addition, encroachment of the color of the lateral line has been noted in specimens of *P. f. flavescens* (two of seven specimens from Kelso and one of 10 specimens from the vicinity of Gavin). The inconsistency of this character among specimens otherwise typical of *perniger*, and its presence in specimens of another subspecies, renders it of little taxonomic use.

Records of occurrence.—Specimens examined, 10, as follows: CUMING COUNTY: Beemer, 3 (USNM). KNOX COUNTY: 1 mi. SE Niobrara, 3; Verdigre, 2 (USNM). STANTON COUNTY: 1½ mi. S Pilger, 2.

Perognathus flavus

Silky Pocket Mouse

The silky pocket mouse is evidently rare in Nebraska and adjacent eastern Wyoming, the northernmost part of the geographic distribution of the species. Only 12 specimens are known from the two

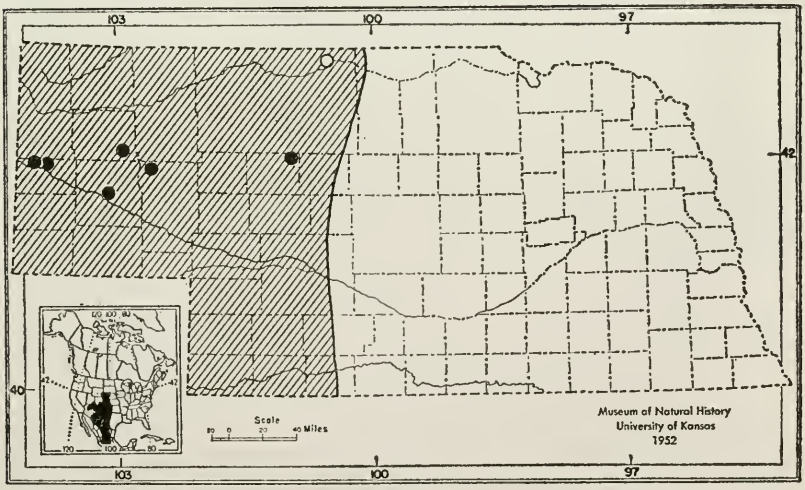

FIG. 35. Distribution of *Perognathus flavus piperi* in Nebraska. For explanation of symbols see Fig. 5.

states; the three from Wyoming that formed the basis of the description of *Perognathus flavus piperi* and the nine herein assigned to that subspecies from Nebraska. The scarcity of *P. flavus* in the northern part of its range is in marked contrast to its relative abundance in the southwestern United States and northern México.

Beed (1936) reported all four species of pocket mice that are known in Nebraska from Ft. Niobrara National Wildlife Refuge on the Crookston Table. This is the only locality from which all have been recorded but the presently known ranges suggest that they may occur together also in the eastern and southern parts of the Panhandle.

No data on reproduction are avaliable for the silky pocket mouse in Nebraska. V. Bailey (1932:275) reported 2-6 young per litter in New Mexico. Four females in the Museum of Natural History from various localities in the southern part of the range of the species carried 2, 3, 3, and 3 embryos.

Perognathus flavus piperi Goldman

Perognathus flavus piperi, Goldman, Proc. Biol. Soc. Washington, 30:148, July 27, 1917 (type locality, 23 mi. SW Newcastle, Weston Co., Wyoming); Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:484, April 21, 1954; Hall and Kelson, The mammals of North America, p. 481, March 31, 1959.

Perognathus flavus, Osgood, N. Amer. Fauna, 18:23, September 20, 1900; Swenk, Proc. Nebraska Acad. Sci., 8:110, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:54, September, 1908.

Perognathus flavus flavus, Swenk, Nebraska Blue Book, p. 853, 1915; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936.

Perognathus flavus bunkeri, Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 5:205, May 14, 1951.

P[erognathus]. f[lavus]. piperi, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Western part of state, east certainly to Cherry and Hooker counties. See Fig. 35.

External measurements.—Average and extreme measurements of four specimens (two males, two females) from Kelso, followed by a male from 8 mi. NNW Scottsbluff, are: 111.0 (107-117), 111; 52.0 (48-57), 51; 15.7 (15-16.3), 17; 6.5 (6.4-6.8), 6. For cranial measurements see Table 12.

Remarks.—Adult specimens from Nebraska, save for the one from 8 mi. NNW Scottsbluff, are smaller in some cranial measurements than the three specimens from Wyoming on which the name *piperi* was based, but in other respects do not differ from them.

No specimens of *Perognathus flavus* have up to now been taken from south of the Platte River in southwestern Nebraska, where the species undoubtedly occurs. When specimens are available from

the southwestern part of Nebraska they may be assignable to *Perognathus flavus bunkeri*, known from adjoining counties in Kansas. *P. f. bunkeri* was said by its describer (Cockrum, 1951:205) to differ from *P. f. piperi* as follows: "Smaller in frontonasal length, mastoidal breadth, and length of auditory bulla; color more buffy, with fewer black hairs dorsally."

Records of occurrence.—Specimens examined, 9, as follows: BOX BUTTE COUNTY: Alliance, 1 (USNM). GARDEN COUNTY: 10 mi. S Antioch, 1 (UMMZ). HOOKER COUNTY: Kelso, 4 (UMMZ). MORRILL COUNTY: 5 mi. N Bridgeport, 1 (MVZ). SCOTTS BLUFF COUNTY: 6 mi. N Mitchell, 1 (NSM); 8 mi. NNW Scottsbluff, 1.

Additional record: CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge (Beed, 1936:21).

Perognathus hispidus

Hispid Pocket Mouse

The hispid pocket mouse is not uncommon in most parts of central and western Nebraska. In the eastern part of the state the species has been taken in pasture lands, along overgrown fence rows, and in the few remaining patches of native prairie. It is, rather surprisingly, common in some places on the Missouri River floodplain in the extreme southeast.

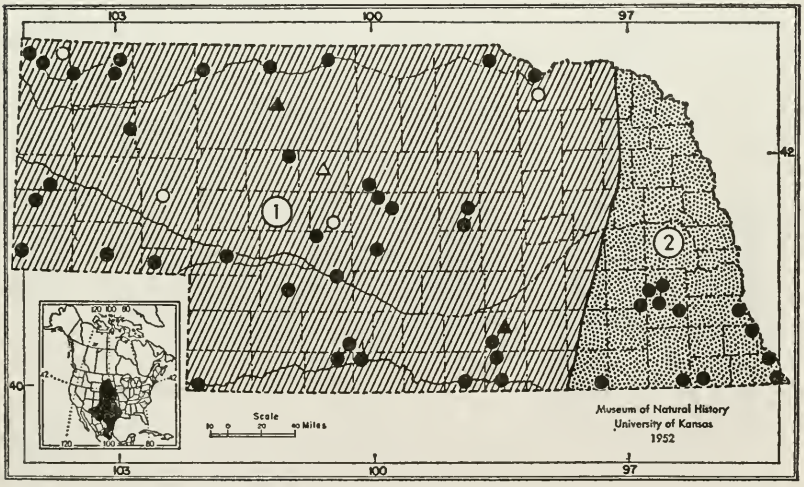

FIG. 36. Distribution of *Perognathus hispidus* in Nebraska. 1. *P. h. paradoxus*. 2. *P. h. spilotus*. For explanation of symbols see Fig. 5.

P. hispidus may be more tolerant of extremely cold weather than the other species of *Perognathus* that occur in Nebraska. On the night of November 29-30, 1957, when the temperature was near 0° F.

and snow partly covered the ground, I trapped two individuals along a fence row 2 mi. E and 1½ mi. S Barnston. Both were frozen solid in the traps.

A young adult female from 4 mi. SW Crawford, taken on August 6, 1957, carried 6 embryos; another from 1½ mi. S Franklin, taken on September 1, 1957, had 5 embryos. A May-taken adult from 1 mi. S Williams had 5 placental scars. Davis (1960:157) reported 2-9 young per litter. Adult females probably bear at least two litters annually.

Perognathus hispidus paradoxus Merriam

Perognathus paradoxus Merriam, N. Amer. Fauna, 1:24, October 25, 1889 (type locality, Banner, Trego Co., Kansas).

Perognathus hispidus paradoxus, Osgood, N. Amer. Fauna, 18:44, September 20, 1900; Carry, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:109, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:53, September, 1908; Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Glass, Jour. Mamm., 28:178, June 1, 1947 (part); Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:484, April 21, 1954; Hall and Kelson, The mammals of North America, p. 495, March 31, 1959.

Perognathus fasciatus, Coues, Proc. Acad. Nat. Sci. Philadelphia, p. 284, August 31, 1875; Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:500, August, 1877; Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Perognathus h[ispidus]. paradoxus, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Perognathus hispidus, Jones, Nebraska Bird Rev., 17:4, 1949.

P[erognathus]. h[ispidus]. paradoxus, Jones, Trans. Kansas Acad. Sci., 60: 277, October 22, 1957.

Distribution in Nebraska.—Western three-fourths of state, east certainly to Adams, Knox, and Webster counties. See Fig. 36.

External measurements.—Average and extreme measurements of 10 adults (nine males, one female) from the Panhandle of western Nebraska are: 220.0 (203-237); 106.6 (93-114); 26.4 (23.5-29.5); 12.9 (12-14). Measurements of a male and three females from the vicinity of Niobrara are, respectively: 227, 225, 216, 210; 115, 114, 108, 103; 27, 29, 27, 27; 13, 15, 13, 12. For cranial measurements see Table 12.

Seven of the specimens from the Panhandle (six males, one female) weighed an average of 47.8 (39.9-59.6) grams.

Remarks.—From *Perognathus hispidus spilotus,* geographically adjacent to the east in Nebraska, *P. h. paradoxus* differs only in paler face (more yellowish), ears (brownish rather than blackish), dorsum (pale brownish lightly admixed with blackish rather than bright, dark ochraceous heavily suffused with blackish), dorsal aspect of tail, and slightly paler lateral line. There is considerable variation among adults of both subspecies in external and cranial

dimensions and no consistent differences between the two were noted in these particulars.

Specimens herein assigned to *paradoxus* from Knox, Valley, and Webster counties, and two of the specimens examined from Adams County, are darker dorsally than specimens from farther west and are intergrades with *spilotus*. The individuals from Valley and Webster counties are, everything considered, nearer *paradoxus* in color than *spilotus*. The specimens from Knox and Adams counties are almost exactly intermediate in color between the two subspecies. Those from Adams County are referred to *paradoxus* because others from there are typical of that race; the specimens from Knox County are assigned to *paradoxus* on geographic grounds.

The specimen listed under Nebraska by Glass (1947:179) from Sterling, Logan County, is from Colorado.

Records of occurrence.—Specimens examined, 116, as follows: ADAMS COUNTY: 6 mi. S Holstein, 1 (NSM); no specific locality, 5 (HM). BANNER COUNTY: 7½ mi. N, 1 mi. E Harrisburg, 1. BLAINE COUNTY: 10 mi. NW Gavin, 1 (UMMZ). BOX BUTTE COUNTY: Box Butte, 12½ mi. N, 5½ mi. E Alliance, 1 (UMMZ). BOYD COUNTY: 4 mi. N Bristow, 1. CHERRY COUNTY: Valentine, 13 (11 UMMZ, 2 UNDZ); *Ft. Niobrara Nat'l Wildlife Refuge, 4 mi. E Valentine,* 3 (1 NSM); Niobrara River, 10-11 mi. S Cody, 3 (2 NSM, 1 USNM); 12 mi. ESE Gordon, 1 (CNHM); no specific locality, 1 (USNM). CHEYENNE COUNTY: 15 mi. S Dalton, 4300 ft., 1. CUSTER COUNTY: 2 mi. NW Gavin, 1 (UMMZ); within ½ mi. Victoria Springs, 6 (UMMZ); Callaway, 1 (USNM). DAWES COUNTY: 3 mi. E Chadron, 1; Chadron State Park, 9 (NGFPC); 3 mi. W Crawford, 1 (NSM); *4 mi. SW Crawford,* 2 (NSM). DEUEL COUNTY: 1 mi. N, 2 mi. W Chappell, 3. DUNDY COUNTY: Haigler, 2 (1 NSM, 1 USNM). FRANKLIN COUNTY: 1½-2 mi. S Franklin, 11. FRONTIER COUNTY: 9¼ mi. S, 6½ mi. E Stockville, 1 (NSM). FURNAS COUNTY: 5 mi. W Holbrook, 4 (UI). HOOKER COUNTY: Kelso, 9 (UMMZ). KEITH COUNTY: 4 mi. N, 7 mi. E Ogallala, 1. KIMBALL COUNTY: Smeed, 1. KNOX COUNTY: 3 mi. W Niobrara, 1; *1-2.2 mi. SE Niobrara,* 5 (3 NGFPC). LINCOLN COUNTY: Myrtle, 2 (USNM); Brady, 1 (NSM); *3½ mi. S Brady,* 1 (NSM); 6 mi. NE Dickens, 1 (UMMZ). RED WILLOW COUNTY: NW of Bartley, 1 (NSM). SCOTTS BLUFF COUNTY: 10-11 mi. S Scottsbluff, 4300-4600 ft., 2. SIOUX COUNTY: 20 mi. NW Harrison, 1 (WSC); Plunkett's Ranch, 10 mi. NE Harrison, 2 (NSM); *6½-7 mi. W Crawford,* 6 (4 NSM); *3½ mi. N, 1 mi. E Glen,* 1 (NSM). VALLEY COUNTY: 2 mi. S, 4 mi. E Ord, 1; 10 mi. S Ord, 3 (NGFPC). WEBSTER COUNTY: Bladen, 2 (HM); Red Cloud, 1 (USNM).

Additional records: GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272). KNOX COUNTY: Verdigre (Cary, MS). LOGAN COUNTY: Gandy (specimen catalogued in AMNH, not now to be found). RED WILLOW COUNTY: *9 mi. NE Bartley* (Jones, 1949*b*:4). SIOUX COUNTY: Orella (Jones, 1949*b*:4); *no specific locality* (Swenk, 1908:109). THOMAS COUNTY: no specific locality (Smith, 1958:60).

Perognathus hispidus spilotus Merriam

Perognathus paradoxus spilotus Merriam, N. Amer. Fauna, 1:25, October 25, 1889 (type locality, Gainesville, Cooke Co., Texas).

Perognathus hispidus spilotus, Black, 30th Biennial Rept., Kansas State Board Agric., p. 83, 1937; Jones and Webb, Jour. Mamm., 30:312, August 14, 1949; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:484, April 21,

1954; Anderson and Nelson, Trans. Kansas Acad. Sci., 61:305, November 21, 1958; Hall and Kelson, The mammals of North America, p. 495, March 31, 1959.

Perognathus hispidus paradoxus, Whelan, Trans. Kansas Acad. Sci., 39:366, 1937; Glass, Jour. Mamm., 28:178, June 1, 1947 (part).

P[erognathus]. h[ispidus]. spilotus, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Southeastern part of state, west certainly to Thayer County, north certainly to Lancaster County. See Fig. 36.

External measurements.—Average and extreme measurements of 10 specimens (five males, five females) from southeastern Nebraska are: 215.5 (190-247); 104.1 (85-120); 26.5 (24.5-29); 12.1 (11.5-13). For cranial measurements see Table 12.

A male and two females from the above series weighed in grams 55.1, 49.5, and 33.7, respectively.

Remarks.—For comparison with *Perognathus hispidus paradoxus,* geographically adjacent the west in Nebraska, see account of that subspecies. The geographic range of *P. h. spilotus* in the state, as presently known, is limited to the southeastern part, south of the Platte River.

Jones and Webb (1949:312) first reported this subspecies from Nebraska. Previously, Glass (1947:178), in discussing the zone of intergradation between *P. h. spilotus* and *P. h. paradoxus,* wrote: "It is evident that it proceeds northeastwards, toward the Missouri River since 2 specimens from eastern Nebraska, a juvenile from Webster County, and an adult from Lancaster County, are both typical *paradoxus.*" The specimen from Lancaster County mentioned by Glass (UMMZ 75573, from 9 mi. N Lincoln) is here referred to *spilotus,* along with four other specimens from the same county and specimens from counties adjacent to Lancaster on both the east and west.

In an earlier paper (Jones, 1954:485) I indicated that *spilotus* differed from *paradoxus* in Nebraska not only in being darker dorsally, but in being smaller, both externally and cranially. This was true as concerns specimens available at that time. Additional material acquired since 1954, however, indicates that *spilotus* is as large as *paradoxus.*

Records of occurrence.—Specimens examined, 29, as follows: GAGE COUNTY: 1 mi. S, 1 mi. W Barnston, 3; *1½ mi. S, 2 mi. E Barnston,* 2; *3 mi. SW Barnston,* 1 (NSM). LANCASTER COUNTY: 9 mi. N Lincoln, 1 (UMMZ); Malcolm (T. 10 N, R. 5 E), 1 (NSM); *College View, Lincoln,* 1 (UC); 1½ mi. S Lincoln, 1 (NSM); Bennett, 1 (NSM). NEMAHA COUNTY: Peru, 1 (NGFPC). OTOE COUNTY: 3 mi. S, 2 mi. E Nebraska City, 3. PAWNEE COUNTY: 4 mi. S, 8 mi. W Pawnee City, 3. RICHARDSON COUNTY: *Barada,* 1 (NSM); 4 mi. E Barada, 6; 3 mi. S Rulo, 1; *5 mi. SE Rulo,* 1. SEWARD COUNTY: Pleasant Dale, 1 (NSM). THAYER COUNTY: 1 mi. S Williams, 1 (NGFPC).

TABLE 12.—CRANIAL MEASUREMENTS OF FOUR SPECIES OF PEROGNATHUS.

Number of specimens averaged or catalogue number, and sex	Occipitonasal length	Zygomatic breadth	Interorbital constriction	Breadth of interparietal	Length of mastoid bullae	Depth of skull	Length of maxillary tooth-row
Perognathus fasciatus fasciatus, Sparks, Cherry County							
68307 UMMZ, ♀	22.1	12.1	4.8	5.0	7.6	8.3	3.4
Perognathus fasciatus clivaceogriseus, Dawes and Sioux counties							
Average 10 (6♂, 4♀)	22.2	11.6	4.9	4.9	7.7	8.5	3.2
Minimum	20.9	11.0	4.6	4.6	7.2	8.2	3.1
Maximum	23.0	11.9	5.3	5.1	8.0	9.0	3.4
Perognathus flavescens flavescens, vicinity type locality							
59104 UMMZ, ♂	21.6	.....	4.7	4.8	7.0	8.1	2.9
77979 KU, ♀	20.9	11.0	4.8	4.8	6.6	8.0	2.9
77980 KU, ♂	21.0	10.8	4.9	5.4	6.7	8.1	3.3
8 mi. NNW Scottsbluff, Scotts Bluff County							
76926 KU, ♀	22.0	11.7	5.0	5.2	7.3	8.4	3.1
76927 KU, ♂	21.8	11.0	5.0	5.0	7.2	8.1	3.2
3¾ mi. S Kearney, in Kearney County							
Average 6 (♂)	21.1	10.8	5.0	4.8	6.9	8.2	3.2
Minimum	20.2	10.3	4.8	4.5	6.7	8.0	3.1
Maximum	21.7	11.3	5.3	5.0	7.3	8.5	3.3
Perognathus flavescens perniger, northeastern Nebraska							
49884 KU, ♂	22.0	.....	5.0	5.0	6.9	8.0	3.1
49886 KU, ♂	22.1	11.4	5.3	4.9	7.2	8.4	3.0
Perognathus flavus piperi, 10 mi. S Antioch, in Garden County							
96073 UMMZ, ♀	21.0	11.0	4.3	3.1	8.1	7.8	3.0
Kelso, Hooker County							
68301 UMMZ, ♀	20.2	10.9	4.3	3.2	7.7	7.7	3.1
68304 UMMZ, ♂	19.6	.....	4.5	3.5	7.5	7.8	3.1
8 mi. NNW Scottsbluff, Scotts Bluff County							
76930 KU, ♂	21.2	11.4	4.3	3.3	7.9	8.2	3.3
Perognathus hispidus paradoxus, western Nebraska							
Average 9 (8♂, 1♀)	32.0	16.5	7.6	8.3	8.7	11.3	5.0
Minimum	30.7	15.6	7.0	7.9	8.3	10.9	4.7
Maximum	33.9	17.2	7.9	8.7	9.4	11.8	5.5
Perognathus hispidus spilotus, southeastern Nebraska							
Average 5 (4♂, 1♀)	32.2	16.0	7.2	8.5	8.6	11.6	4.8
Minimum	31.4	15.1	6.9	8.0	8.3	11.2	4.5
Maximum	33.8	16.8	7.9	9.0	9.2	12.2	5.0

Dipodomys ordii

Ord's Kangaroo Rat

Ord's kangaroo rat is one of the most conspicuous small mammals on the Sand Hills and adjacent arid regions of western Nebraska. The eastern limit of distribution in the state nearly coincides with the 98th meridian, and records form Antelope, Knox, and Platte counties are the northeasternmost in North America.

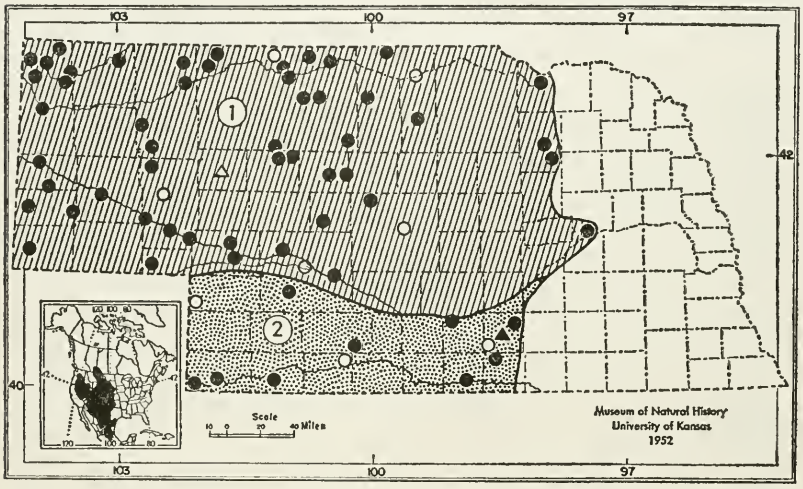

FIG. 37. Distribution of *Dipodomys ordii* in Nebraska. 1. *D. o. luteolus.* 2. *D. o. richardsoni.* For explanation of symbols see Fig. 5.

Dipodomys ordii prefers sandy soils and it is no wonder, therefore, that the species is abundant on the Sand Hills, especially in areas overgrazed by cattle where "blowouts" are common. Dozens, sometimes hundreds, can be seen there on roads at night in but a few miles driving. On the High Plains to the west of the Sand Hills, on the Pine Ridge, and in some areas to the south of the Platte River in western Nebraska, the species is on the average less numerous than on the Sand Hills and often is localized in distribution.

Like pocket mice, Ord's kangaroo rat is sometimes difficult to trap at times in the year when native foods are available in abundance, but individuals can be caught readily by hand or shot along roadsides at night in all seasons.

Thirteen pregnant females taken in the months of May through September carried an average of 3.1 (2-5) embryos. A juvenile obtained on May 3, 1958, indicates that some litters are born as early as April.

Dipodomys ordii luteolus (Goldman)

Perodipus ordii luteolus Goldman, Proc. Biol. Soc. Washington, 30:112, May 23, 1917 (type locality, Casper, Natrona Co., Wyoming); Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

Dipodomys ordii luteolus, Grinnell, Jour. Mamm., 2:96, May 2, 1921; Hoffmeister, Proc. Biol. Soc. Washington, 55:166, December 31, 1942; Setzer, Univ. Kansas Publ., Mus. Nat. Hist., 1:533, December 27, 1949; Hall and Kelson, The mammals of North America, p. 516, March 31, 1959.

Dipodomys ordii, Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:710, 1859; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 93, 1875; Jones, Nebraska Bird Rev., 20:10, January, 1952.

Dipodomys Ordii, Hayden, Trans. Amer. Philos. Soc., 12 (n.s.):147, 1863.

Dipodomys phillipsi ordi, Coues, Proc. Acad. Nat. Sci., Philadelphia, p. 326, August 31, 1875; Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:541, August, 1877.

Dipodomys ordi, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Perodipus longipes, Allen, Bull. Amer. Mus. Nat. Hist., 8:246, November 25, 1896.

Perodipus richardsoni, Cary, Proc. Nebraska Ornith. Union, 3:65, 68-69, December, 1902; Elliot, Field Columb. Mus., Zool. Ser. (Publ. 115), 8:330, 1907.

Perodipus montanus richardsoni, Swenk, Proc. Nebraska Acad. Sci., 8:109, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:63, September, 1908.

Peroidipus [sic] montanus richardsoni, Swenk, Nebraska Blue Book, p. 853, 1915.

Dipodomys ordii richardsoni, Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936.

Dipodomys o[rdii]. richardsoni, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

D[ipodomys]. o[rdii]. luteolus, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Western three-fourths of state north of Platte River, east certainly to Antelope, Knox, and Platte counties. See Fig. 37.

External measurements.—Average and extreme measurements of 10 specimens (seven males, three females) from 4 mi. E Valentine are: 266.0 (245-276); 147.6 (139-156); 41.8 (40-44); 13.5 (12-15). For cranial measurements see Table 13.

Eight of the specimens from 4 mi. E Valentine (five males, three females) weighed an average of 65.7 (55.9-78.1) grams.

Remarks.—For comparison with *Dipodomys ordii richardsoni,* geographically adjacent to the south in Nebraska, see account of that subspecies.

Specimens from the Panhandle of Nebraska agree with topotypes of *D. o. luteolus* in size (external and cranial) and color, excepting those from the Pine Ridge and adjacent areas, which average slightly darker but do not differ otherwise. Some series from the Sand Hills average slightly paler than topotypes and are the palest

of specimens from anywhere within the geographic range of *luteolus*. Here again, however, no differences other than color were noted.

The Platte River forms, more or less, the boundary between the presently known ranges of *D. o. luteolus* and *D. o. richardsoni* in Nebraska, but the placing there of the boundary is more a matter of convenience than of significance. In actual fact the Platte does not seem to be a barrier to kangaroo rats and, on the basis of specimens I have seen, no break is perceptible there or elsewhere in the broad zone of intergradation between the two subspecies.

Records of occurrence.—Specimens examined, 349, as follows: ANTELOPE COUNTY: Neligh, 9 (8 NSM, 1 USNM); *1 mi. SW Neligh*, 4; Oakdale, 1 (USNM). BANNER COUNTY: *9 mi. N, 5 mi. E Harrisburg*, 3; 10 mi. W Harrisburg, 1 (NSM); 8 mi. SW Redington, 3 (NSM). BROWN COUNTY: Johnstown, 1 (USNM). CHERRY COUNTY: 10 mi. W Merriman, 1 (CNHM); W of Crookston, 3 (NSM); Valentine, 15 (2 UNDZ, 13 USNM); *4 mi. E Valentine*, 17; *Ft. Niobrara Nat'l Wildlife Refuge*, 1 (USNM); *Clark's Canyon, near Valentine*, 13 (USNM); 15 mi. E Gordon, 1 (CNHM); 8 mi. S Nenzel, 1; *Niobrara River*, 4 (USNM); 18 mi. NW Kennedy, 3 (1 NSM, 2 USNM); *Watt's Lake, Valentine Nat'l Wildlife Refuge*, 1 (UC); *½ mi. W Headquarters, Valentine Nat'l Wildlife Refuge*, 2 (UC); *Hackberry Lake, Valentine Nat'l Wildlife Refuge*, 29 (21 UMMZ); 2 mi. W to 4 mi. E Kennedy, 22 (2 MVZ, 10 USNM); 11 mi. E Kennedy, 5; *Rice Lake, Valentine Nat'l Wildlife Refuge*, 1 (CNHM); *Valentine Nat'l Wildlife Refuge*, 1 (NSM); 30 mi. S Woodlake, 6 (CNHM); North Fork, Middle Loup River, NW of Mullen, 7 (NSM); *Sand Hills*, 2 (USNM). CUSTER COUNTY: *1-2 mi. NW Gavin*, 8 (1 MVZ, 7 UMMZ); 7-8 mi. NW Anselmo, 7 (UMMZ). DAWES COUNTY: 3 mi. E Chadron, 1; *NW of Crawford*, 1 (NSM). DEUEL COUNTY: 1 mi. N, 2 mi. W Chappell, 1. GARDEN COUNTY: 10 mi. S Antioch, 5 (UMMZ); 3 mi. S Lisco, 3; 2 mi. S Oshkosh, 3; *Cooper's Ranch, near Oshkosh*, 1 (NSM), Windlass Hill (2 mi. SE Lewellen), 1; *no specific locality*, 2. HOOKER COUNTY: Kelso, 5 (UMMZ); Mullen, 1 (RV). KEITH COUNTY: 4 mi. NNW Keystone, 7; 1-4 mi. N, 7 mi. E Ogallala, 2. KEYA PAHA COUNTY: 12 mi. NNW Springview, 2. KIMBALL COUNTY: 4 mi. S Bushnell, 1 (NGFPC). KNOX COUNTY: 1½ mi. SE Niobrara, 1 (NGFPC); *2.2 mi. S Niobrara*, 1 (NGFPC). LINCOLN COUNTY: Birdwood Creek, 8 mi. N, 4 mi. W Hershey, 2950 ft., 2; *Birdwood Creek*, 4 (USNM); *N of Brady*, 4 (NSM); Brady, 2 (NSM); *2-3 mi. SE Brady*, 1 (NSM). LOGAN COUNTY: 2 mi. NE Stapleton, 6. MORRILL COUNTY: Bridgeport, 1 (NSM); *5 mi. E Bridgeport*, 1; *3 mi. NW Lisco*, 7. PLATTE COUNTY: 6 mi. S Monroe, 1 (UC). ROCK COUNTY: Perch, 16 (14 AMNH, 2 CNHM). SCOTTS BLUFF COUNTY: Mitchell, 1 (NSM); *8 mi. NNW Scottsbluff*, 3; 10 mi. S Scottsbluff, 4300 ft., 2. SHERIDAN COUNTY: Gordon, 1 (NSM); 11 mi. S Gordon, 3; 16 mi. NE Alliance, 4 (UMMZ); 4-5 mi. N Antioch, 8 (UMMZ). SIOUX COUNTY: 16 mi. NW Crawford, 1 (NSM); Jim Creek, 1 (NSM); *Warbonnet Canyon*, 6 (NSM); *10 mi. N Harrison*, 1 (NGFPC); Plunkett's Ranch, 10 mi. NE Harrison, 1 (NSM); Harrison, 1 (NSM); 5½-7 mi. W Crawford, 8 (7 NSM); *1 mi. S, 4 mi. W Crawford*, 1 (NSM); Glen, 1 (NSM); Agate, 3 (2 CNHM, 1 UMMZ); *3 mi. E Agate*, 1. THOMAS COUNTY: *5 mi. N Headquarters, Nebraska Nat'l Forest*, 2 (UNDZ); *4 mi. W Halsey*, 2; Halsey, 9 (6 AMNH, 1 NSM, 2 UNDZ); *1 mi. S, 3½ mi. W Halsey*, 20; *Nebraska Nat'l Forest*, 8 (NGFPC); 2 mi. S, 10 mi. W Halsey, 3 (UC); *Dismal River*, 2 (USNM). County unknown: *Niobrara River*, 1 (USNM); *"Nebraska,"* 1 (USNM).

Additional records: CHERRY COUNTY: Cody (Cary, MS); *North Marsh Lake, Valentine Nat'l Wildlife Refuge* (Jones, 1952:10). CUSTER COUNTY: Broken Bow (Swenk, 1908:108). GARDEN COUNTY: Crescent Lake Nat'l

Wildlife Refuge (Imler, 1945:272). GRANT COUNTY: no specific location (Rapp and Gates, 1957:53). KEYA PAHA COUNTY: Carns (Swenk, 1908:108). LINCOLN COUNTY: vicinity North Platte (Swenk, MS). SHERIDAN COUNTY: *12 mi. S Gordon* (Setzer, 1949:534). SIOUX COUNTY: *Orella* (Jones, 1949*b*:5).

Dipodomys ordii richardsoni (J. A. Allen)

Dipodops richardsoni J. A. Allen, Bull. Amer. Mus. Nat. Hist., 3:277, June 30, 1891 (type locality, "one of the sources of the Beaver [North Canadian] River in the extreme northwestern corner of the [Indian] Territory, of the so-called 'neutral Strip'; "probably Harper Co., Oklahoma, according to Blair, Amer. Midland Nat., 22:116, July, 1939).

Dipodomys ordii richardsoni, Grinnell, Jour. Mamm., 2:96, May 2, 1921; Setzer, Univ. Kansas Publ., Mus. Nat. Hist., 1:513, December 27, 1949; Hall and Kelson, The mammals of North America, p. 517, March 31, 1959.

Perodipus ordii richardsoni, Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

D[ipodomys]. o[rdii]. richardsoni, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Western part of state south of Platte River, east certainly to Adams and Webster counties. See Fig. 37.

External measurements.—Average and extreme measurements of five males from 5 mi. N and 2 mi. W Parks are: 258.2 (244-281); 140.6 (129-150); 41.4 (41-42); 12.4 (12-13). Measurements of two males and a female from 3¾ mi. S Kearney are, respectively: 267, 262, 267; 148, 150, 144; 44, 42, 43; 13, 14, 13. For cranial measurements see Table 13.

Two males from 5 mi. N and 2 mi. W Parks weighed 71.8 and 74.2 grams.

Remarks.—According to Setzer (1949:512) *D. o. richardsoni* differs from *Dipodomys ordii luteolus* as follows: "Size smaller in external measurements except length of body which is longer; color darker, except on plantar surfaces of hind feet and dorsal and ventral stripes of tail which are lighter; ventral stripe of tail, in most specimens, continuous to end of pencil, whereas in *D. o. luteolus* ventral stripe is present on only proximal two-thirds; skull larger in all measurements taken; zygomatic arch heavier; auditory bullae relatively as well as actually more inflated; external auditory meatus egg-shaped as contrasted to nearly round in *D. o. luteolus;* pterygoid fossae rounded as compared to ovate in *D. o. luteolus.*"

Nebraskan specimens herein assigned to *richardsoni* are intergrades between that subspecies and *luteolus* (as are some specimens assigned to the latter) but agree more closely with examples of *richardsoni* from the Oklahoma Panhandle than with topotypes of *luteolus* in external and cranial measurements, color of upper parts, and size of auditory bullae. The other characters mentioned by Setzer are variable in the vast majority of Nebraskan specimens of *D. ordii* and thereby of little taxonomic use in this study.

Records of occurrence.—Specimens examined, 37, as follows: ADAMS COUNTY: Hastings, 1 (HM); no specific locality, 1 (AMNH). DUNDY

COUNTY: 5 mi. N Parks, 3 (NGFPC); *5 mi. N, 2 mi. W Parks,* 6; Haigler, 1 (USNM). FRANKLIN COUNTY: 1 mi. SE Franklin, 1. FRONTIER COUNTY: 15-17 mi. SE Stockville, 6 (NSM). HITCHCOCK COUNTY: 8 mi. S, 3 mi. W Trenton, 1. KEARNEY COUNTY: 3¾ mi. S Kearney, 3. LINCOLN COUNTY: 6 mi. NE Dickens, 1 (UMMZ). WEBSTER COUNTY: Bladen, 12 (10 AMNH, 2 HM). County unknown: *South Platte River, 380 mi. from Ft. Riley,* 1 (USNM).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). PERKINS COUNTY: Venango (Swenk, MS). RED WILLOW COUNTY: 9 mi. NE Bartley (Jones, 1949*b*:5).

TABLE 13.—CRANIAL MEASUREMENTS OF TWO SUBSPECIES OF DIPODOMYS ORDII.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Mastoid breadth	Interorbital constriction	Length of nasals	Maxillary breadth	Depth of skull	Length of maxillary tooth-row
Dipodomys ordii luteolus, 4 mi. E Valentine, Cherry County							
Average 10 (7♂, 3♀)	39.2	23.8	13.0[9]	14.5	21.0	14.2	5.4
Minimum	38.0	23.3	11.9	13.8	19.8	13.9	5.0
Maximum	40.6	24.9	13.8	15.3	22.2	14.7	5.6
vicinity Crawford, in Sioux County							
Average 5 (2♂, 3♀)	39.2	24.0	13.3	14.4	21.6	14.0	5.2
Minimum	37.7	23.0	12.9	13.7	21.0	13.8	4.8
Maximum	39.8	24.6	13.8	14.9	22.0	14.2	5.7
Dipodomys ordii richardsoni, 5 mi. N, 2 mi. W Parks, Dundy County							
Average 5 (♂)	40.1	24.4	12.9	14.7	21.7	14.0	5.3
Minimum	39.3	23.8	12.7	14.1	21.5	13.7	5.1
Maximum	41.1	24.9	13.5	15.8	22.2	14.2	5.6
3¾ mi. S Kearney, in Kearney County							
69043 KU, ♂	39.6	24.1	12.3	14.8	21.7	13.6	5.4
69044 KU, ♀	41.0	24.8	12.2	15.1	21.7	14.2	5.4
69045 KU, ♂	40.0	24.2	12.6	15.1	22.3	14.1	5.4

Family CASTORIDAE—Beavers

Castor canadensis

Beaver

The demand on the fur market in the 1800's for beaver pelts and the premium prices paid for them were important factors leading to the exploration and early settlement of Nebraska. Save for the several exploring expeditions sponsored by the Federal Government nearly all the exploration of Nebraska prior to the Gold Rush of 1849 was carried out by trappers and persons who traded with the Indians. The trappers and traders sought principally beaver. Trad-

ing posts sprang up along the Missouri, and later along the Platte and other rivers, many to become the nuclei of villages and towns.

Examination of the historical literature reveals that the beaver was abundant along Nebraskan waterways when Caucasians first reached the state. Intensive trapping steadily reduced numbers to a point where the continued existence of the species in the state was threatened, resulting in legislation in 1907 that afforded the beaver complete protection. Even though the number of beaver in Nebraska was much reduced, the animal fared better there than in some neighboring states. Aughey (1880:121) wrote that the species was "mostly confined to western and northern Nebraska, though a few linger on most of the streams of the State." Swenk (1908:89) cited Aughey's observation and reported that the "same conditions largely prevail today." Swenk recorded beaver in "considerable colonies" in Warbonnet Canyon, Sioux County, and mentioned that individuals still occurred along the Blue and Elkhorn rivers in eastern Nebraska.

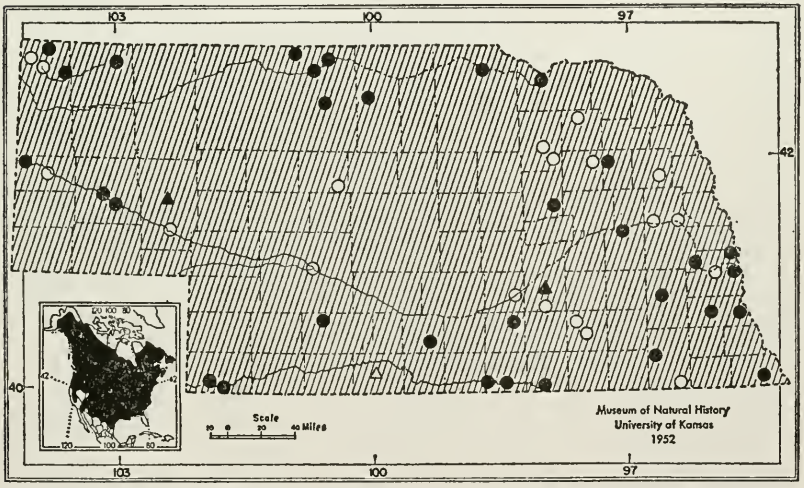

FIG. 38. Distribution of *Castor canadensis missouriensis* in Nebraska. For explanation of symbols see Fig. 5.

Swenk's unpublished notes on Nebraskan mammals contain many references concerning the relative abundance of beaver in the state for the period 1910 to 1930, especially along the larger rivers, where much damage was claimed by farmers. One newspaper account dated 1919 reported: "The entire stretch of the Republican river is beaver-ridden, so is the Platte west of Grand Island and the Nio-

brara has them by the hundreds all along." Of course, this was at a time when the best beaver pelts brought $40 or more and obviously some reports of damage to agriculture were exaggerated by persons interested only in trapping. Nevertheless, it seems that the number of beaver never became so low in Nebraska as to place the species in danger of extinction.

As mentioned, the beaver was afforded complete protection in Nebraska in 1907. In 1945 a part of the state was opened to limited trapping. From 1946 through 1951 no trapping was allowed but since 1952 the entire state has been open to trapping in a prescribed season each year. In the years when the species was protected special permits were issued for control of beaver at places where population levels and activity justified it.

Today, *Castor canadensis* occurs in every county of the state and is so common in some places that the Game, Forestation and Parks Commission annually receives complaints of damage. Biologists employed by the Commission explain that, owing to the low prices paid for beaver pelts in late years, there is little interest in trapping beaver and numbers cannot, therefore, be adequately controlled. Even so, owing to conflict with the interests of man, it seems unlikely that the species will attain its former abundant status. I know of no beaver introduced into Nebraska and assume native stock to be responsible for the existing population.

Females probably bear only one litter annually in Nebraska. Four females from eastern Nebraska taken in March (two) and April (two) contained 3, 4, 5, and 6 embryos. A female from Sioux County obtained on August 7, 1957, had 3 placental scars but was no longer lactating.

Castor canadensis missouriensis V. Bailey

Castor canadensis missouriensis V. Bailey, Jour. Mamm., 1:32, November 28, 1919 (type locality, Apple Creek, 7 mi. E Bismarck, Burleigh Co., North Dakota); Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:30, October, 1936; Swenk, Nebraska Bird Rev., 5:55, July 31, 1937; Velich, Jour. Mamm., 42:93, February 20, 1961.

Castor fiber, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Castor Canadensis, Hayden, Trans. Amer. Philos. Soc., 12 (n. s.):146, 1863; Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Castor fiber var. *canadensis*, J. A. Allen, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:444, August, 1877.

Castor canadensis, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Castor canadensis fondator [sic], Swenk, Proc. Nebraska Acad. Sci., 8:90, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:34, September, 1908.

Castor canadensis frondator, Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919.

Castor canadensis missourienses [sic], Swenk, Nebraska Blue Book, p. 480, December, 1920.

C[astor]. c[anadensis]. missouriensis, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 38.

Measurements.—External measurements of a male and female from the vicinity of Niobrara, a female from 9 mi. SW Valentine, a female from 6 mi. N Midway, and a female from 1 mi. W Montrose are, respectively: 1042, 940, 1067, 1168, 1104; 362, 330, 343, 290, 376; 178, 175, 191, 170, 192; —, —, —, 37, 37. The largest Nebraska-taken specimen known, a female from Barnston, yielded external measurements as follows: 1212; 302; 184; —.

A male and two females from Louisville weighed, respectively, 50, 44, and 40 lbs. The female from 1 mi. W Montrose weighed 54 lbs.; the one from Barnston (which was pregnant with 6 embryos) weighed 72 lbs.

Average and extreme cranial measurements of six adults (three males, three females) from Morrill County are: Condylobasal length, 130.4 (125.2-140.2); zygomatic breadth, 94.5 (90.4-104.1); length of nasals, 45.7 [5] (44.0-47.4); mastoid breadth, 71.3 (67.8-79.1); least constriction across squamosals, 44.2 (42.7-46.9); interorbital breadth, 24.0 (21.4-29.4); alveolar length of maxillary tooth-row, 30.2 (28.5-32.4).

Records of occurrence.—Specimens examined, 109, as follows: ADAMS COUNTY: Hastings, 1 (HM). BOONE COUNTY: near Boone, 2 (NSM). BROWN COUNTY: *[Long] Pine Creek,* 2 (AMNH); Johnstown, 1 (USNM); *6 mi. SW Johnstown,* 1 (AMNH); *Calamus River,* 1 (AMNH). BUTLER COUNTY: Platte River, 1. CASS COUNTY: Plattsmouth, 1 (RV); *Missouri River, near Plattsmouth,* 1 (NSM); *no specific locality,* 1 (NSM). CHERRY COUNTY: Kilgore, 1 (NSM); *20 mi. W Valentine,* 1 (UC); Valentine, 1 (UNDZ); *vicinity Valentine,* 15 (USNM); *8 mi. S Valentine,* 1 (MVZ); *9 mi. SW Valentine,* 1 (MVZ); 10 mi. SW Valentine, 1 (MVZ); Valentine Nat'l Wildlife Refuge, 2 (1 USNM); *no specific locality,* 2 (1 NSM, 1 UC). DAWES COUNTY: Pepper Creek, near Chadron, 1 (CSTC). DUNDY COUNTY: Rock Creek, N of Parks, 3; Republican River, 5 mi. E Parks, 1. FRONTIER COUNTY: Curtis, 1 (HM). GAGE COUNTY: Homestead Nat'l Mon., 1. GARDEN COUNTY: no specific locality, 1 (NSM). HAMILTON COUNTY: no specific locality, 1 (HM). HOLT COUNTY: 6 mi. N Midway, 1. KEYA PAHA COUNTY: *Burton Creek,* 1 (AMNH); *Niobrara River,* 2 (AMNH). KNOX COUNTY: Niobrara, 1 (NSM); *Missouri River, near Niobrara,* 3 (NSM). LANCASTER COUNTY: 5½ mi. NW Lincoln, 1 (UNDZ). MORRILL COUNTY: Bridgeport, 28 (1 CNHM, 27 NSM); 3 mi. W Broadwater, 1 (NSM). NUCKOLLS COUNTY: Superior, 2 (HM). OTOE COUNTY: Syracuse, 1 (NSM); Missouri River, near Nebraska City, 1 (NSM). PHELPS COUNTY: Holdrege, 2 (HM). RICHARDSON COUNTY: Falls City, 1 (NSM). ROCK COUNTY: *30 mi. S Bassett,* 4 (AMNH). SARPY COUNTY: Bellevue, 1 (HM). SAUNDERS COUNTY: 5 mi. N, 2½ mi. E Ashland, 3 (NSM). SCOTTS BLUFF COUNTY: 5 mi. W Mitchell, 1 (NSM); *2 mi. W Mitchell,* 1 (NSM). SIOUX COUNTY: 1 mi. W Montrose, 1 (NSM); 5½ mi. W Crawford, 1 (NSM). STANTON COUNTY: Elkhorn River, 1 mi. S, 8 mi. E Norfolk, 1; *Elkhorn River,* 1 (NSM). WEBSTER COUNTY: Inavale, 1 (HM); Red Cloud, 1 (HM). County unknown: *Platte River,* 2 (1 UMMZ, 1 USNM).

Additional records: ANTELOPE COUNTY: Neligh (Cary, MS); Oakdale (Swenk, MS). BROWN COUNTY: *Niobrara River* (Cary, MS). CASS COUNTY: Louisville (record on file, NGFPC). CHERRY COUNTY: *Niobrara River* (Cary, MS); *Ft. Niobrara Nat'l Wildlife Refuge* (Beed, 1936:30). CUMING COUNTY: West Point (Swenk, MS). DODGE COUNTY: 1 mi. E North Bend (Velich, 1961:93); near Fremont (record on file, NGFPC). FILLMORE COUNTY: 3½ mi. SW Grafton (record on file, NGFPC). SW of Geneva (record on file, NGFPC). FURNAS COUNTY: no specific locality (Swenk, MS). GAGE COUNTY:

Barnston (record on file, NGFPC). GARDEN COUNTY: near Oshkosh (Swenk, MS). HALL COUNTY: Platte River, S of Grand Island (record on file, NGFPC). HAMILTON COUNTY: N of Harvard (Swenk, MS). KNOX COUNTY: *Manuel's Creek, below [on Missouri River] mouth of Niobrara* (not exactly located) (Hayden, 1863:146). LANCASTER COUNTY: *Salt Creek, within 12 mi. Lincoln* (Swenk, 1908:89); *Lincoln* (Swenk, MS). LINCOLN COUNTY: Junction of Platte rivers (Swenk, MS). MADISON COUNTY: Elkhorn River, near Norfolk (Swenk, MS). PIERCE COUNTY: Osmond (Velich, 1961:93). SCOTTS BLUFF COUNTY: Scotts Bluff Nat'l Mon. (Mattes, 1958:57). SIOUX COUNTY (Swenk, 1908:89): Jim Creek; *Warbonnet Canyon; Biehle's Creek; Monroe Creek;* Sowbelly Creek. THOMAS COUNTY: Dismal River (Swenk, MS; *no specific locality* (Smith, 1958:61).

Family CRICETIDAE—Native Rats and Mice

KEY TO NEBRASKAN CRICETIDS

1. Cheek-teeth cusped, occlusal surface lacking lakes of dentine surrounded by enamel....2
1′. Cheek-teeth lacking cusps, occlusal surface composed of lakes of dentine surrounded by enamel....7
2(1). Pelage coarse, relatively hispid; hind foot more than 24; maxillary tooth-row more than 5.0....*Sigmodon hispidus*, p. 212
2′. Pelage relatively smooth; hind foot less than 24; maxillary tooth-row less than 5.0....3
3(2′). Length of head and body less than 80; upper incisors grooved on anterior surface....4
3′. Length of head and body usually more than 80; upper incisors smooth....5
4(3). Dark color on dorsum of tail a thin median line; breadth of braincase 9.7 or less....*Reithrodontomys montanus*, p. 191
4′. Dark color on dorsum of tail a relatively broad stripe; breadth of braincase 9.6 or more (usually 9.8 or more). *Reithrodontomys megalotis*, p. 187
5(3′). Tail less than 60 per cent of length of head and body; coronoid process long, extending higher than articular process. *Onychomys leucogaster*, p. 207
5′. Tail more than 60 per cent of length of head and body; coronoid process short, not extending higher than articular process....6
6(5′). Tail sharply bicolored; hind foot 21 or less (usually less than 20); braincase flattened and roughly parallel-sided. *Peromyscus maniculatus*, p. 199
6′. Tail not sharply bicolored (except occasionally in winter); hind foot 20 or more; braincase rounded, not flattened or parallel-sided. *Peromyscus leucopus*, p. 194
7(1′). Tail more than 100; greatest length of skull more than 35....8
7′. Tail less than 100; greatest length of skull less than 35....10
8(7). Tail laterally compressed; fringe of stiff hairs on toes of hind feet; maxillary tooth-row more than 12....*Ondatra zibethicus*, p. 234
8′. Tail rounded; toes of hind feet lacking stiff hairs; maxillary tooth-row less than 12....9
9(8′). Tail bushy; soles of hind feet furred from heel to plantar tubercle; nasal septum divided by prominent noteh....*Neotoma cinerea*, p. 214
9′. Tail fully haired but not bushy; soles of hind feet naked; nasal septum complete....*Neotoma floridana*, p. 215
10(7′). Tail approximately same length as hind foot; zygomatic breadth usually more than 17.5; upper incisors grooved on anterior surface. *Synaptomys cooperi*, p. 220

10′. Tail longer than hind foot; zygomatic breadth usually less than 17.5; upper incisors smooth.....11

11(10′). Dorsum blackish or brownish black, venter grayish or whitish; 8 mammae; fourth triangle of M2 having prominent heel that oftentimes appears as a distinct fifth triangle.
Microtus pennsylvanicus, p. 227

11′. Dorsum brownish or reddish, venter usually washed with buff; 4 or 6 mammae; fourth triangle of M2 lacking heel.....12

12(11′). Tail 29 or more; pelage relatively coarse, brownish or brownish gray dorsally; 6 mammae.....*Microtus ochrogaster*, p. 222

12′. Tail less than 29 (usually less than 25); pelage soft and smooth, chestnut dorsally; 4 mammae.....*Microtus pinetorum*, p. 231

Reithrodontomys megalotis

Western Harvest Mouse

The western harvest mouse, a common inhabitant of grassy areas throughout Nebraska, is widely distributed in the eastern part of the state, but frequently is restricted to riparian communities in the western part. The species probably is more widespread now than formerly in some western areas owing to irrigation. Lush, lowland swales seem to provide the optimum habitat for this mouse but it

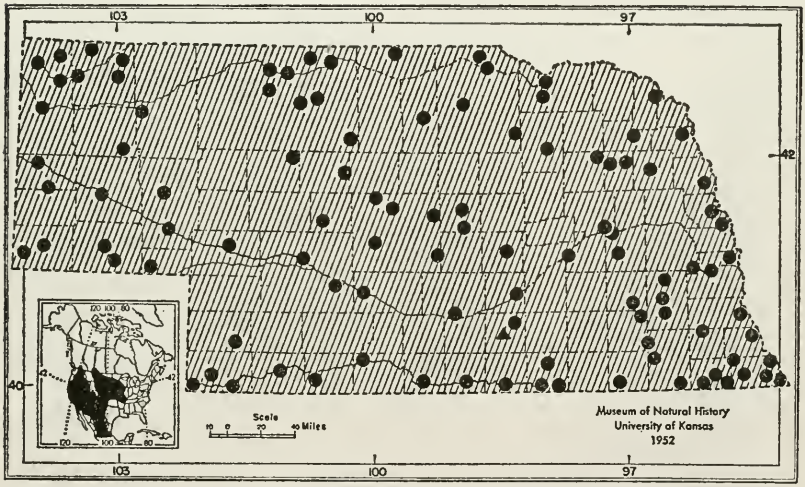

FIG. 39. Distribution of *Reithrodontomys megalotis dychei* in Nebraska. For explanation of symbols see Fig. 5.

lives also in weedy fencerows, thickets, fallow fields, and on dry upland areas where ground cover is abundant. Considering Nebraska as a whole, *R. megalotis* is second in abundance among native mammals only to the deer mouse, *Peromyscus maniculatus.*

In color of pelage at least, the western harvest mouse varies less

in Nebraska than any other of the wide-ranging cricetid rodents; mice from the western part of the state average only slightly paler than those from the east. In external and cranial measurements, too, variation is slight, although individuals from southwestern counties have somewhat longer tails and longer rostra than specimens from elsewhere in the state. Geographic variation in the species on the central Great Plains and in adjacent regions was summarized by Jones and Mursaloğlu (1961). Color abberations evidently are rare in *R. megalotis;* none was discovered in more than 1200 specimens examined from Nebraska and surrounding states.

Judging from available data, the western harvest mouse breeds in all but the winter months in Nebraska. Seventy-five pregnant females, taken in the months of April through November, had an average of 4.3 (2-8) embryos; the mode was 4.

Reithrodontomys megalotis dychei J. A. Allen

Reithrodontomys dychei J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:120, May 21, 1895 (type locality, Lawrence, Douglas Co., Kansas); J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:252, November, 1896; Swenk, Proc. Nebraska Acad. Sci., 8:97, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:41, September, 1908 (part).

Reithrodontomys megalotis dychei, A. H. Howell, N. Amer. Fauna, 36:30, June 5, 1914; Swenk, Nebraska Blue Book, p. 852, 1915, Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Poole and Schantz, Bull. U. S. Nat. Mus., 178:342, April 9, 1942; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:388, May 12, 1958; Jones, Jour. Mamm., 41:132, February 20, 1960; Jones and Mursaloğlu, Univ. Kansas Publ., Mus. Nat. Hist., 14:21, July 24, 1961.

Ochetodon humilis [sic], Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Reithrodontomys dychei nebrascensis J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:122, May 21, 1895 (type locality, Kennedy, Cherry Co., Nebraska); Swenk, Proc. Nebraska Acad. Sci., 8:98, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:42, September, 1908 (part); Lyon and Osgood, Bull. U. S. Nat. Mus., 62:116, January 28, 1909.

[Reithrodontomys dychei] nebrascensis, Cary, Proc. Biol. Soc. Washington, 16:53, May 6, 1903.

Rhithrodontomys [sic] dychii [sic], Elliot, Field Columb. Mus., Publ. 115 (Zool. Ser.), 8:256, 1907.

R[eithrodontomys]. m[egalotis]. dychei, Hanson, Field Mus. Nat. Hist., Zool. Ser., 29:206, October 26, 1944; Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 39.

External measurements.—Average and extreme measurements of 27 specimens (19 males, eight females) from Cherry County are: 134.7 (122-155); 62.8 (56-73); 17.4 (17-18); 12.8 (11-14). For cranial measurements see Table 14; for additional external and cranial measurements see Jones and Mursaloğlu (1961).

Ten males from Cherry County weighed an average of 13.3 (11.7-14.7) grams and a female from there weighed 14.2; six males from southeastern Nebraska weighed an average of 11.8 (10.6-12.6) grams and two females weighed 13.5 and 14.1.

Remarks.—When J. A. Allen (1895*a*:122-123) named "*Reithrodontomys dychei nebrascensis*" from Kennedy, Nebraska, he characterized it (p. 123) in comparison with the subspecies *dychei* as having "slightly larger size, slightly larger ears, and very much stronger suffusion of fulvous" dorsally. Allen further remarked: "In coloration it is parallel to the phase of *Peromyscus* found over the same region, and known as *P. americanus nebrascensis [= P. maniculatus luteus]*, as compared with other conspecific forms of the latter group." The subspecies *R. d. nebrascensis* stood as valid in the literature until A. H. Howell (1914:30-31) placed it in synonymy under *dychei* (which was there regarded for the first time as a subspecies of *R. megalotis*) because he found (p. 31) specimens of *nebrascensis* "to be indistinguishable from specimens of typical *dychei* in comparable pelage."

Examination of 839 specimens of the species *R. megalotis* from Nebraska, along with direct comparisons of topotypes of *nebrascensis* with topotypes of *dychei*, convinces me that Howell was justified in denying recognition to *nebrascensis* (see also Jones and Mursaloğlu, 1961:22). Specimens from Cherry County and from adjacent areas in western Nebraska do not average larger in any external or cranial dimensions, and average only slightly paler in comparable pelage, than specimens from eastern Nebraska and those from the type locality of *dychei*. Adults of *R. megalotis*, in Nebraska at least, have two distinct pelages annually, the paler of which is acquired in winter. Specimens in worn winter pelage are paler than those taken at any other time of year. The type of *nebrascensis* and other specimens available to Allen from the vicinity of Kennedy all were collected in late April and all are in worn winter pelage, which accounts for Allen's contention that they were more fulvous dorsally than mice from farther east. Also, Allen erred in thinking that variation in color in *R. megalotis* on the Great Plains paralleled that found in *Peromyscus maniculatus;* geographic variation in color of pelage is much more pronounced in the latter species than in *R. megalotis*.

Specimens of *R. m. dychei* from southwestern Nebraska, especially those from Dundy and Hitchcock counties, average larger than specimens from anywhere else in the state and approach *R. m.*

aztecus in some measurements, especially in length of rostrum (average 7.5 in 16 adults from the mentioned counties).

Records of occurrence.—Specimens examined, 839, as follows: ADAMS COUNTY: Hastings, 1 (HM); no specific locality, 2 (HM). ANTELOPE COUNTY: Neligh, 16 (6 NSM, 9 USNM). BOYD COUNTY: 5 mi. WNW Spencer, 1; 5 mi. S, 2 mi. E Spencer, 2; *6 mi. SSE Spencer,* 1. BOX BUTTE COUNTY: Alliance, 2 (USNM). BUFFALO COUNTY: Kearney, 2 (USNM). BURT COUNTY: 1 mi. E Tekamah, 3. BUTLER COUNTY: 2 mi. N, 2 mi. W Bellwood, 2 (NSM); 4-5 mi. E Rising City, 11; *4 mi. E, 1 mi. S Rising City,* 5. CHASE COUNTY: 2 mi. SE Enders, 1. CHERRY COUNTY: W of Crookston, 1 (NSM); Valentine, 2 (USNM); *Ft. Niobrara Nat'l Wildlife Refuge, 4 mi. E Valentine,* 6 (3 NSM, 1 UNDZ); *3 mi. SSE Valentine,* 4; *3 mi. S Valentine,* 12; Niobrara River, 10 mi. S Cody, 2 (1 USNM); 8 mi. S Nenzel, 2; *11 mi. S, 2 mi. W Nenzel,* 1; *18 mi. NW Kennedy,* 8 (2 NSM, 6 USNM); Two Mile Lake (sec. 12, T. 31 N, R. 34 W), 6 (4 NSM, 2 USNM); *Watt's Lake, Valentine Nat'l Wildlife Refuge,* 4; Hackberry Lake, Valentine Nat'l Wildlife Refuge, 26 (12 UMMZ); *½ mi. W Headquarters, Valentine Nat'l Wildlife Refuge,* 1 (UC); 2 mi. W to 4 mi. E Kennedy, 25 (4 UMMZ, 12 USNM); *Pelican Lake, Valentine Nat'l Wildlife Refuge,* 5 (2 NGFPC, 3 UC); 30 mi. S Woodlake, 4 (CNHM); *no specific locality,* 1 (USNM). CHEYENNE COUNTY: 15 mi. S Dalton, 4300 ft., 1; *3 mi. N Sidney,* 6; 4 mi. E Sidney, 42. CUMING COUNTY: Beemer, 1 (USNM). CUSTER COUNTY: 7 mi. NW Anselmo, 1 (UMMZ); within 1 mi. Victoria Springs, 9 (UMMZ); *2 mi. E Lillian,* 1 (UMMZ); Comstock, 4 (3 AMNH, 1 NSM); Callaway, 3 (USNM); 6 mi. SE Mason City, 1 (UMMZ). DAWES COUNTY: Wayside, 1; 3 mi. E Chadron, 2; *6 mi. S Chadron,* 1 (NSM); *8 mi. S Chadron,* 1 (NSM); 10 mi. S Chadron, 1 (UMMZ); *1 mi. W Crawford,* 2 (NSM); Crawford, 5 (3 AMNH, 2 UMMZ). DAWSON COUNTY: ½ mi. S Gothenburg, 5; *3 mi. SSE Gothenburg,* 4. DEUEL COUNTY: 1 mi. N, 2 mi. W Chappell, 3. DIXON COUNTY: 3 mi. NE Ponca, 4. DUNDY COUNTY: Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, 46 (4 NGFPC); *2 mi. N, 2 mi. W Haigler,* 1; *Arikaree River, Parks,* 2; 2 mi. SW Benkleman, 7; Haigler, 3 (1 NSM, 2 USNM). FRANKLIN COUNTY: 1½-2 mi. S Franklin, 10. FURNAS COUNTY: 4 mi. W Holbrook, 1 (UI). GAGE COUNTY: 1 mi. SE DeWitt, 3; ¼ mi. W Homestead Nat'l Mon., 1; 1 mi. S, 1 mi. W Barnston, 1; *1½ mi. S, 2 mi. E Barnston,* 18. GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge, 1; ½ mi. S Oshkosh, 1. HALL COUNTY: 6 mi. S Grand Island, 5. HARLAN COUNTY: 1 mi. W Alma, 17. HITCHCOCK COUNTY: Republican River, Trenton, 3. HOOKER COUNTY: Kelso, 3 (UMMZ). HOLT COUNTY: *6 mi. N Midway,* 4; 1 mi. S Atkinson, 4 (2 NSM); Ewing, 1 (USNM). HOWARD COUNTY: 1 mi. S St. Paul, 1 (NGFPC). JEFFERSON COUNTY: 7 mi. S, 2 mi. W Fairbury, 6; *3 mi. S, 1 mi. W Endicott,* 1. JOHNSON COUNTY: 1 mi. S, 1½ mi. E Burr, 1. KEARNEY COUNTY: *1¾-3¾ mi. S Kearney,* 6. KEITH COUNTY: 4 mi. WNW Keystone, 69. KEYA PAHA COUNTY: 12 mi. N Springview, 8; *12 mi. NNW Springview,* 5. KIMBALL COUNTY: 3 mi. E Kimball, 1; Smeed, 40. KNOX COUNTY: *3 mi. W Niobrara,* 2; 1-1½ mi. SE Niobrara, 6 (1 NGFPC); *2 mi. S Niobrara,* 2; Verdigre, 2 (USNM). LANCASTER COUNTY: 12 mi. N Lincoln, 2 (UC); within 5 mi. Lincoln, 48 (3 AMNH, 4 CNHM, 8 NSM, 1 RV, 13 UC, 6 UNDZ); 8 mi. S Lincoln, 1 (UC). LINCOLN COUNTY: 2 mi. N North Platte, 1; Conroy Canyon, SW corner sec. 4, T. 11 N, R. 27 W (5 mi. S, 2½ mi. W Brady), 2 (NSM). LOGAN COUNTY: 1-2 mi. NE Stapleton, 11. MADISON COUNTY: Norfolk, 1 (USNM). MORRILL COUNTY: 1 mi. N Bridgeport, 4. NEMAHA COUNTY: 2 mi. SW Peru, 6; *3 mi. S, 1½ mi. E Peru,* 2. NUCKOLLS COUNTY: 5 mi. N, ½ mi. E Nelson, 1 (UNM); 2 mi. WSW Superior, 5; 1 mi. SSW Hardy, 9. OTOE COUNTY: 1 mi. SE Nebraska City, 3; *3 mi. S, 2 mi. E Nebraska City,* 3. PAWNEE COUNTY: Turkey Creek, 4 mi. NW Pawnee City, 2 (NSM); 4 mi. S, 8 mi. W Pawnee City, 7; 1 mi. S Du Bois, 4. PLATTE COUNTY: Columbus, 4 (1 UNDZ, 3 USNM); *3½ mi. E Columbus,* 1 (UNDZ). POLK COUNTY: 15 mi. W Osceola, 2. RED WILLOW COUNTY: 5 mi. S, 2½ mi. E McCook, 2; *8 mi. S, 3 mi. E McCook,* 2. RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 2 (1 NSM); 4 mi. E Barada, 16; 3½ mi. S, 1 mi. W Dawson, 6; 2 mi. N Falls City, 2; *4-6 mi. W*

Falls City, 4; ½ mi. S, 1½ mi. W Rulo, 1. ROCK COUNTY: Perch, 23 (21 AMNH, 2 CNHM). SALINE COUNTY: 2 mi. NE Crete, 1; *½ mi. W DeWitt*, 1. SARPY COUNTY: *1 mi. SE Bellevue*, 1 (UNDZ); Fort Crook, 1 (AMNH); 1 mi. W Meadow, 1. SAUNDERS COUNTY: 2 mi. NW Ashland, 3. SCOTTS BLUFF COUNTY: *8 mi. NNW Scottsbluff*, 1; Mitchell, 1 (NSM); *½-1 mi. S Mitchell*, 13; *5 mi. S Gering*, 10; *7 mi. S Gering*, 1; 11-12 mi. S Scottsbluff, 4600-4800 ft., 8; *12 mi. SSW Scottsbluff, 4700 ft.*, 5. SEWARD COUNTY: Milford, 1 (CNHM). SHERIDAN COUNTY: 18 mi. S Hay Springs, 1 (WSC). SIOUX COUNTY: 1 mi. S, 4 mi. W Orella, 1 (NSM); 8 mi. N Harrison, 2 (UMMZ); *Monroe Canyon, 5½ mi. N, 2½ mi. W Harrison*, 4 (NGFPC); *Monroe Canyon*, 1 (AMNH); *6½-7 mi. W Crawford*, 3 (1 NSM); *3½ mi. N, 1 mi. E Glen*, 1 (NSM); *3 mi. NE Glen*, 1 (NSM); Glen, 3 (NSM); Agate, 4600 ft., 1. STANTON COUNTY: 1½ mi. S Pilger, 3; 8 mi. SE Norfolk, 1. THOMAS COUNTY: 1 mi. W Halsey, 2; *Halsey*, 5 (4 AMNH, 1 NSM). THURSTON COUNTY: 1 mi. S Winnebago, 8. VALLEY COUNTY: 2 mi. W Ord, 1; *2 mi. S, 4 mi. E Ord*, 6; 10 mi. S Ord, 10 (NGFPC). WASHINGTON COUNTY: 1 mi. E Blair, 6; *3 mi. SE Blair*, 2; *6 mi. SE Blair*, 7; 3 mi. S, 2 mi. E Ft. Calhoun, 1 (NSM). WAYNE COUNTY: ½ mi. W to 2½ mi. E Wayne, 3. WEBSTER COUNTY: 3 mi. S Red Cloud, 2.

Reithrodontomys montanus

Plains Harvest Mouse

This harvest mouse seemingly lives exclusively in upland habitats. The western harvest mouse, *Reithrodontomys megalotis*, sometimes taken in upland areas with *montanus*, generally inhabits more mesic associations. *R. montanus* is another species for which the Missouri River and its riparian association provide a barrier to eastward dispersal. The species is nowhere known from east of the Missouri, although it reaches the bluffs of that river in northern Nebraska and adjacent South Dakota and occurs within a few miles of the Missouri in southeastern Nebraska and northeastern Kansas. The

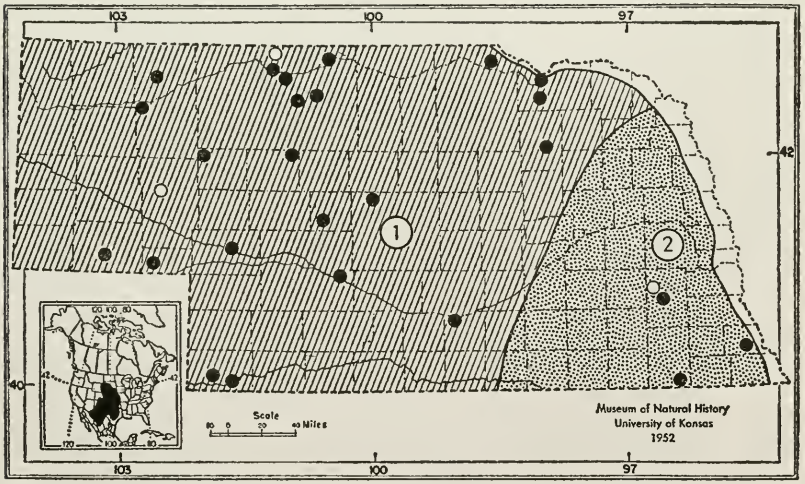

FIG. 40. Distribution of *Reithrodontomys montanus* in Nebraska. 1. *R. m. albescens*. 2. *R. m. griseus*. For explanation of symbols see Fig. 5.

plains harvest mouse is known throughout western Nebraska, except that no specimens are presently available from the Pine Ridge or adjacent areas in the northwestern part of the state. The known distribution of the species suggests, however, its occurence there.

Some specimens of *Reithrodontomys montanus* are difficult to distinguish from those of *R. megalotis* but (when compared directly with *megalotis*) the vast majority can be fairly easily identified as follows: upper parts usually paler, having a distinct, dark mid-dorsal stripe; dorsal stripe on tail much narrower; buffy postauricular patch usually present; smaller, both externally and cranially (see measurements); rostrum relatively shorter; braincase narrower; lateral margins of skull as a whole more nearly straight-sided when viewed from above, mostly owing to the narrower braincase.

Females are polyestrous, probably breed throughout the warmer months of the year, and according to Hall and Kelson (1959:582) have 2-5 young per litter. A female from 3 mi. SE Brady gave birth to 5 young in a live-trap on the night of June 22-23, 1939. Three pregnant females from Anderson County, Kansas (two taken in March, one in July), carried 3, 4, and 5 embryos.

Reithrodontomys montanus albescens Cary

Reithrodontomys albescens Cary, Proc. Biol. Soc. Washington, 16:53, May 6, 1903 (type locality, 18 mi. NW Kennedy, Cherry Co., Nebraska); Swenk, Proc. Nebraska Acad. Sci., 8:99, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:45, September, 1908; Lyon and Osgood, Bull. U. S. Nat. Mus., 62:111, January 28, 1909.

Reithrodontomys montanus albescens, Cary, N. Amer. Fauna, 33:110, August 17, 1911; Benson, Jour. Mamm., 16:141, May 15, 1935; Poole and Schantz, Bull. U. S. Nat. Mus., 178:341, April 9, 1942; Hall and Kelson, The mammals of North America, p. 582, March 31, 1959.

Reithrodontomys albescens albescens, A. H. Howell, N. Amer. Fauna, 36:22, June 5, 1914; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936.

Reithrodontomys a[lbescens]. albescens, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

R[eithrodontomys]. m[ontanus]. albescens, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Western two-thirds of state, east certainly to Antelope, Kearney, and Knox counties. See Fig. 40.

External measurements.—Average and extreme measurements of eight specimens (seven males, one female) from Cherry County, including the holotype and three topotypes, are: 124.5 (113-133.5); 54.7 (48-60); 16.5 (16-17); 12.5^3 (12-13). Corresponding measurements of seven specimens (four males, three females) from Dundy and Kearney counties are: 118.7 (113-125); 53.0 (48-60); 15.9 (15-17); 12.6 (11-15). For cranial measurements see Table 14.

Three males from Kearney County and two males from Boyd County

weighed, respectively, 10.2, 10.9, 10.0, 11.3, and 11.6 grams; a female from Dundy County weighed 10.5 grams.

Remarks.—From *Reithrodontomys montanus griseus,* geographically adjacent to the southeast in Nebraska, *R. m. albescens* differs principally in paler upper parts and dorsal stripe of tail (in *albescens* the upper parts are pale grayish to pale brownish whereas in *griseus* the upper parts, taken as a whole, average near buffy brown and the middorsal stripe is darker than in *albescens*). Judging from specimens currently available from the northern part of the range of *R. m. griseus* (Kansas and Nebraska), *albescens* may average slightly larger than *griseus* in external and cranial dimensions but there is complete overlap among specimens of the two subspecies that I have seen.

Specimens of *R. m. albescens* from Cherry County and other localities in the Sand Hills average slightly more grayish dorsally than mice from other Nebraskan localities; some specimens from Antelope, Boyd, Knox, and Kearney counties are somewhat darker dorsally than examples from farther west and evidence intergradation with *griseus.*

The type locality of *albescens,* 18 mi. NW Kennedy, is noted elsewhere by its describer (Cary, MS) as being on "the sand hills north of the Snake River," where several specimens were taken (Cary, 1903:54) "by overturning millet shocks in a sandy field."

Records of occurrence.—Specimens examined, 70, as follows: ANTELOPE COUNTY: Neligh, 12 (4 NSM, 8 USNM); *1 mi. SW Neligh,* 1. BOYD COUNTY: 4 mi. N Bristow, 2. CHERRY COUNTY: Valentine, 1 (UNDZ); Niobrara River, 10 mi. S Cody, 2 (1 NSM, 1 USNM); 18 mi. NW Kennedy, 7 (3 NSM, 4 USNM), including the holotype; *Watt's Lake, Valentine Nat'l Wildlife Refuge,* 1 (UC); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 6 (5 UMMZ); *E side Duck Lake, Valentine Nat'l Wildlife Refuge,* 1 (UC); Kennedy, 1 (USNM); *4 mi. E Kennedy,* 1. CHEYENNE COUNTY: 15 mi. S Dalton, 4300 ft., 2. CUSTER COUNTY: *1-4 mi. NW Gavin,* 5 (UMMZ); 7-8 mi. NW Anselmo, 2 (UMMZ). DEUEL COUNTY: 1 mi. N, 2 mi. W Chappell, 1. DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 3; 2 mi. SW Benkleman, 2. GRANT COUNTY: 5 mi. W Ashby, 1 (MVZ). HOOKER COUNTY: Kelso, 2 (UMMZ). KEARNEY COUNTY: 3¾ mi. S Kearney, 3. KEITH COUNTY: 4 mi. WNW Keystone, 3. KNOX COUNTY: Niobrara, 1 (USNM); Verdigre, 4 (USNM). LINCOLN COUNTY: 3 mi. SE Brady, 1 (NSM). LOGAN COUNTY: 1-2 mi. NE Stapleton, 3. SHERIDAN COUNTY: 6 mi. W Rushville, 1 (NGFPC); 16 mi. NE Alliance, 1 (UMMZ).

Additional records: CHERRY COUNTY: Cody (Cary, 1903:54); *Ft. Niobrara Nat'l Wildlife Refuge* (Beed, 1936:21). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272).

Reithrodontomys montanus griseus V. Bailey

Reithrodontomys griseus V. Bailey, N. Amer. Fauna, 25:106, October 24, 1905 (type locality, San Antonio, Bexar Co., Texas); Swenk, Proc. Nebraska Acad. Sci., 8:99, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:43, September, 1908.

Reithrodontomys montanus griseus, Benson, Jour. Mamm., 16:141, May 15, 1935; Hall and Kelson, The mammals of North America, p. 583, March 31, 1959.

Reithrodontomys dychei, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:120, May 21, 1895.

Reithrodontomys albescens griseus, A. H. Howell, N. Amer. Fauna, 36:23, June 5, 1914; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Whelan, Trans. Kansas Acad. Sci., 39:366, 1937.

R[eithrodontomys]. m[ontanus]. griseus, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Southeastern part of state. See Fig. 40.

External measurements.—Measurements of two males and two females from the vicinity of Lincoln are, respectively: 111, 105, 115, 119; 49, 41, 52, 48; 15, 14, 16, 14; 15, 11 (crown), —, 10 (crown). For cranial measurements see Table 14.

The weight of five specimens (four males, one female) from Douglas County, Kansas, averaged 8.3 (6.9-9.5) grams.

Remarks.—For comparison with *Reithrodontomys montanus albescens*, geographically adjacent to the west in Nebraska, see account of that subspecies.

R. m. griseus is seemingly uncommon in Nebraska, probably owing to destruction in the eastern part of the state of most of the original upland prairie. According to Swenk (MS), however, Grace Kiernan Weber trapped this mouse with some frequency in upland situations at the southeastern edge of Lincoln in the autumn and winter of 1928-29. Swenk himself (1908:99) reported it as "not common" on the salt flats near [north and west of] Lincoln, indicating that it inhabited "dry open fields and prairies." I personally have taken only one specimen in the state.

R. m. griseus presently is known in Nebraska only from south of the Platte River.

Records of occurrence.—Specimens examined, 8, as follows: GAGE COUNTY: 1 mi. S, 1 mi. W Barnston, 1. LANCASTER COUNTY: Lincoln, 3 (2 AMNH, 1 NGFPC); *Capitol Beach* (*Lincoln*), 1 (NSM); *College View* (*Lincoln*), 1 (CNHM). NEMAHA COUNTY: London, 2 (USNM).

Additional record: LANCASTER COUNTY: 9 mi. NW Lincoln (Whelan, 1937:366).

Peromyscus leucopus

White-footed Mouse

The white-footed mouse is characteristically an inhabitant of wooded areas and is commonest in Nebraska along the eastern border of the state where deciduous woodlands are fairly extensive. In other parts of eastern Nebraska the species occurs mainly in the wooded bottomland along streams, but is found also in the remaining patches of upland timber, woodlots, shelter belts, hedgerows,

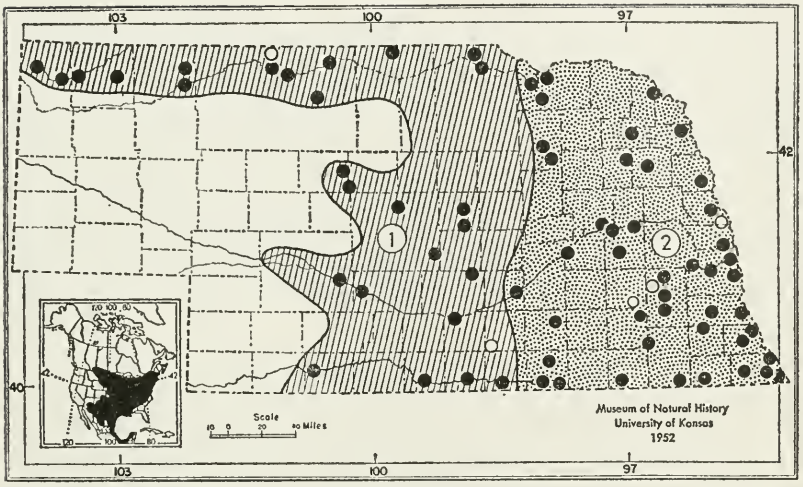

FIG. 41. Distribution of *Peromyscus leucopus* in Nebraska. 1. *P. l. aridulus.* 2. *P. l. noveboracensis.* For explanation of symbols see Fig. 5.

and sometimes on brushy hillsides and along over-grown fencerows in patches of sumac and wild plum.

Suitable habitat for *P. leucopus* is restricted in most parts of central and western Nebraska to deciduous riparian communities along stream courses and consequently the distribution of the species assumes a dendritic pattern within the range of *P. l. aridulus.* The white-footed mouse is not especially common, or only locally so, in most areas where it occurs in the western part of the state and its distribution may be discontinuous in some places. So far as known, the species does not occur along the Republican River in extreme southwestern Nebraska nor along the western reaches of the Platte and its tributaries and I assume that deciduous timber along these rivers is not extensive enough (or at least was not extensive enough prior to settlement by white men) to support populations of this mouse. On the Pine Ridge in extreme northwestern Nebraska individuals occasionally are taken on conifer-covered hills and slopes, especially in or near outcropping rock, as well as along streams.

Throughout its range in Nebraska *P. leucopus* is sympatric with the deer mouse (*Peromyscus maniculatus*) and the two species are frequently taken in the same trap line, although *P. maniculatus* typically lives in non-wooded habitats. *P. leucopus* can be distinguished in Nebraska from *P. maniculatus* as follows: size larger, especially length of tail and length of hind foot; upper parts gen-

erally duller, tail less pilose and less sharply bicolored (except in some instances in winter pelage); skull larger, braincase decidedly more inflated (both dorsally and laterally), auditory bullae larger. In extreme northwestern Nebraska some individuals of *P. m. nebrascensis* reach the linear external and cranial dimensions of *P. l. aridulus* but have more buffy upper parts, usually have smaller skulls, and have the narrower, flatter braincase and smaller bullae.

The species breeds in Nebraska throughout the warmer months of the year. Forty-three pregnant females, taken in the months of April through October, carried an average of 4.4 (2-6) embryos; the mode was 5.

Peromyscus leucopus aridulus Osgood

Peromyscus leucopus aridulus Osgood, N. Amer. Fauna, 28:122, April 17, 1909 (type locality, Fort Custer, Big Horn Co., Montana); Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Hall and Kelson, The mammals of North America, p. 629, March 31, 1959.

Hesperomys leucopus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880 (part).

Peromyscus texianus subarcticus, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Peromyscus subarcticus, Swenk, Proc. Nebraska Acad. Sci., 8:96, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:40, September, 1908.

Peromyscus leucopus, Swenk, Proc. Nebraska Acad. Sci., 8:96, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:40, September, 1908 (part).

[Peromyscus leucopus] aridulus, Dice, Contrib. Lab. Vert. Genetics, Univ. Michigan, 4:2, January, 1937.

P[eromyscus]. l[eucopus]. aridulus, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Central and northwestern parts of state, east certainly to Boyd, Holt, Valley, Buffalo, and Webster counties. See Fig. 41.

External measurements.—Average and extreme measurements of 25 specimens (16 males, nine females) from the vicinity of Valentine are: 173.2 (161-186); 74.8 (68-81); 22.2 (21-23); 15.8 (15-17). For cranial measurements see Table 14.

Eight specimens (five males, three females) from northwestern Nebraska weighed an average of 30.5 (27.5-35.6) grams.

Remarks.—From *Peromyscus leucopus noveboracensis*, geographically adjacent to the east in Nebraska, *P. l. aridulus* differs principally in color, having distinctly paler upper parts and dorsum of tail in both summer and winter pelages. Nebraskan specimens of the two subspecies do not differ in external or cranial measurements with the possible exception of zygomatic breadth, which averages more in specimens of *aridulus* that I have studied. Osgood (1909:123)

described *aridulus* as being larger (as well as paler) than *noveboracensis* but the difference is not borne out by the measurements he listed. He referred specimens from the eastern parts of Nebraska and Kansas to *noveboracensis* but remarked that they were "apparently intermediate between *noveboracensis* and *aridulus*, having the darker color of *noveboracensis* and the larger size of *aridulus*."

As might be expected, specimens from the eastern part of the range of *aridulus* in Nebraska average darker dorsally than individuals from farther west and are intergrades with *noveboracensis*. This is especially true of specimens from Boyd, Holt, and Valley counties.

Because the distribution of *P. l. aridulus* assumes a dendritic pattern along the major river systems of the central Great Plains, most of which are eastward-flowing, it is conceivable that mice of the subspecies from along the western part of one river system are more closely related genetically to mice from along the same river farther eastward—mice that are nominally of the subspecies *noveboracensis*—than to individuals of *aridulus* from the same longitude but from along other river systems. If this is true, populations from throughout much of the range of *aridulus* reflect similar and independent adaptation to a similar environment rather than relationship in the strict sense, because gene-flow between them is restricted or entirely absent. On the other hand, the geographic distribution of *aridulus* may have been, as I suspect, much more extensive in a warmer, wetter post-Wisconsin period than it is today, and the dendritic segments thus could be relics of a once more or less continuous and interbreeding population.

Records of occurrence.—Specimens examined, 242, as follows: BLAINE COUNTY: Dismal River, 2 mi. S, 8 mi. W Dunning, 5. BOYD COUNTY: 5 mi. WNW Spencer, 1; *6 mi. SSE Spencer*, 3. BUFFALO COUNTY: 1 mi. E Ravenna, 3 (UMMZ). CHERRY COUNTY: Valentine, 34 (3 NSM, 19 UMMZ, 3 UNDZ, 9 USNM); *Ft. Niobrara Nat'l Wildlife Refuge, 4 mi. E Valentine*, 8 (3 NSM); *3 mi. S Valentine*, 12; *3 mi. SSE Valentine*, 16; Niobrara River, 10 mi. S Cody, 7 (3 NSM, 4 USNM); Niobrara River, 18 mi. NW Kennedy, 1; Hackberry Lake, Valentine Nat'l Wildlife Refuge, 3 (1 UMMZ). CUSTER COUNTY: 2 mi. E Lillian, 1 (UMMZ); 6 mi. SE Mason City, 1 (UMMZ). DAWES COUNTY: *6-8 mi. S Chadron*, 3 (NSM); *Chadron State Park*, 2 (NGFPC); 10 mi. S Chadron, 27 (UMMZ); *1 mi. W Crawford*, 1 (NSM); Crawford, 2 (UMMZ). DAWSON COUNTY: *4 mi. E Gothenburg*, 1 (UC); ½ mi. S Gothenburg, 5. FRANKLIN COUNTY: 1½ mi. S Franklin, 5. HARLAN COUNTY: 1 mi. S Alma, 6. HOLT COUNTY: 6 mi. N Midway, 11. KEARNEY COUNTY: 1¾ mi. S Kearney, 4. KEYA PAHA COUNTY: 12 mi. N Springview, 2; *12 mi. NNW Springview*, 11. LINCOLN COUNTY: Platte River, sec. 14, T. 12 N, R. 27 W (1½ mi. S Brady), 1 (NSM). RED WILLOW COUNTY: McCook, 4 (2 NSM, 2 WFR). SHERIDAN COUNTY: Gordon, 2 (NSM); 11 mi. S Gordon, 5. SIOUX COUNTY: *Warbonnet Canyon*, 4 (NSM); 5½ mi. N, 2½ mi. W Harrison, 7 (NGFPC); *Monroe Canyon, 5 mi. N Harrison*, 5 (UMMZ); *Monroe Canyon, 4 mi. N, 2 mi. W Harrison*, 5 (NSM); *West Monroe Canyon, N of Harrison*, 5 (NSM); *1 mi. S, 4 mi. W Crawford*, 3 (NSM); Glen, 15 (3 AMNH, 12 NSM).

THOMAS COUNTY: 4 mi. W Halsey, 1; *1-1½ mi. W Halsey,* 2 (1 UC); *Nebraska Nat'l Forest,* 2 (1 NGFPC, 1 UNDZ). VALLEY COUNTY: 2 mi. W Ord, 3; 10 mi. S Ord, 1 (NGFPC). WEBSTER COUNTY: 3 mi. S Red Cloud, 1.

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). CHERRY COUNTY: Cody (Swenk, 1908:96).

Peromyscus leucopus noveboracensis (Fischer)

Mus sylvaticus δ *noveboracensis* Fischer, Synopsis mammalium, p. 318, 1829 (type locality, New York).

Peromyscus leucopus noveboracensis, Miller, Proc. Boston Soc. Nat. Hist., 28:22, April 30, 1897; Osgood, N. Amer. Fauna, 28:117, April 17, 1909; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Whelan, Trans. Kansas Acad. Sci., 39:366, 1937; Jones and Webb, Jour. Mamm., 30:312, August 17, 1949; Hall and Kelson, The mammals of North America, p. 630, March 31, 1959; Jones, Jour. Mamm., 41:132, February 20, 1960.

?*Mus agrarius,* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Hesperomys (*Vesperimus*) *leucopus,* Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:50, August, 1877.

Hesperomys leucopus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880 (part).

Peromyscus leucopus, Swenk, Proc. Nebraska Acad. Sci., 8:96, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:40, September, 1908 (part).

P[eromyscus]. l[eucopus]. noveboracensis, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Eastern part of state, west certainly to Knox, Antelope, Hall, and Nuckolls counties, See Fig. 41.

External measurements.—Average and extreme measurements of 25 specimens (14 males, 11 females) from 4 mi. E Barada are: 180.0 (169-188); 80.3 (75-87); 21.4 (20-23); 16.0 (15-17). For cranial measurements see Table 14. Twelve specimens (five males, seven females) from southeastern Nebraska weighed an average of 27.7 (21.4-33.5) grams.

Remarks.—For comparison with *Peromyscus leucopus aridulus,* geographically adjacent to the west in Nebraska, see account of that subspecies.

Except for specimens from the southeastern part of the state, all others herein assigned to *P. l. noveboracensis* from Nebraska average paler than specimens from Ohio, Pennsylvania, and New York, and are intergrades with *P. l. aridulus.* Specimens from localities near the western edge of the range of *noveboracensis* in Nebraska, from Neligh and Saronville for example, resemble specimens from along the Missouri River in Burt and Washington counties slightly more than they resemble specimens of *aridulus* from Valentine, but are almost exactly intermediate between specimens of *aridulus* from western Nebraska and specimens of *noveboracensis* from the eastern

United States. Assignment of specimens from some localities within the zone of intergradation between the two subspecies is admittedly arbitrary.

Records of occurrence.—Specimens examined, 476, as follows: ANTELOPE COUNTY: Neligh, 5 (3 NSM, 2 USNM); *1 mi. SW Neligh,* 5; Oakdale, 1 (NSM). BURT COUNTY: 1 mi. E Tekamah, 2. BUTLER COUNTY: 4 mi. N, ½ mi. E Octavia, 2 (NSM); 2 mi. N, 2 mi. W Bellwood, 2 (NSM); 4-5 mi. E Rising City, 14. CASS COUNTY: Louisville, 1 (NGFPC); Rock Bluff, 2 (UNDZ). CLAY COUNTY: Saronville, 4 (UF). CUMING COUNTY: 1 mi. S Beemer, 10. DIXON COUNTY: 3 mi. NE Ponca, 9. DOUGLAS COUNTY: Ralston, 1 (RV). GAGE COUNTY: 1 mi. SE De Witt, 1; 1 mi. S, 1 mi. W Barnston, 4; *1½ mi. S, 2 mi. E Barnston,* 3; *2 mi. S, ½ mi. E Barnston,* 4; *3 mi. SW Barnston,* 1 (NGFPC). HALL COUNTY: 6 mi. S Grand Island, 8. JEFFERSON COUNTY: 7 mi. S, 2 mi. W Fairbury, 1; *3 mi. S, 1 mi. W Endicott,* 1. JOHNSON COUNTY: 1 mi. S, 1½ mi. E Burr, 6. KNOX COUNTY: *3 mi. W Niobrara,* 3; *Niobrara State Park,* 2 (NGFPC); *1 mi. W Niobrara,* 1; 1 mi. SE Niobrara, 1; *2 mi. S Niobrara,* 5; 8 mi. SW Niobrara, 1 (NGFPC); Verdigre, 2 (USNM). LANCASTER COUNTY: 12 mi. N Lincoln, 3 (UC); within 6 mi. Lincoln, 140 (1 CM, 1 NGFPC, 17 NSM, 105 UC, 21 UNDZ); 8 mi. S Lincoln, 8 (UC). NEMAHA COUNTY: *3 mi. N Peru,* 2; Peru, 2 (NSM); *2 mi. SW Peru,* 3; *3 mi. S, 1½ mi. E Peru,* 3; *London,* 1 (USNM); South Auburn, 4 (USNM). NUCKOLLS COUNTY: 2 mi. E Nelson, 7 (UNM); 2 mi. WSW Superior, 6; 1 mi. SSW Hardy, 1. OTOE COUNTY: 1 mi. SE Nebraska City, 5; *1 mi. S Nebraska City,* 1 (MSU); 1 mi. S Syracuse, 1 (WFR); *3 mi. S, 2 mi. E Nebraska City,* 2. PAWNEE COUNTY: 4 mi. S, 8 mi. W Pawnee City, 19. PLATTE COUNTY: 3½ mi. E Columbus, 1 (UNDZ). POLK COUNTY: 15 mi. W Osceola, 2. RICHARDSON COUNTY: 4 mi. E Barada, 52; 3½ mi. S, 1 mi. W Dawson, 7; 2 mi. N Falls City, 1; *4 mi. W Falls City,* 1; ½ mi. S, 1½ mi. W Rulo, 1; *3-5 mi. SE Rulo,* 10 (7 NGFPC). SALINE COUNTY: *2 mi. NE Crete,* 3; Crete, 4 (WFR). SARPY COUNTY: Fontanelle Forest, 1 (UNDZ); 2 mi. SE La Platte, 4; *1 mi. W Meadow,* 2. SAUNDERS COUNTY: 2 mi. NW Ashland, 9. STANTON COUNTY: 1½ mi. S Pilger, 3. THURSTON COUNTY: ¾ mi. E Winnebago, 2; *1 mi. S Winnebago,* 3. WASHINGTON COUNTY: Blair, 21 (2 RV, 19 UMMZ); *1 mi. E Blair,* 8; *3 mi. SE Blair,* 22; *6 mi. SE Blair,* 2. WAYNE COUNTY: Wayne, 7. County unknown: *Platte River Junction,* 1 (NSM).

Additional records: LANCASTER COUNTY: 9 mi. NW Lincoln (Whelan, 1937:366). SEWARD COUNTY: Milford (Swenk, MS). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369).

Peromyscus maniculatus

Deer Mouse

The deer mouse is without question the most abundant mammalian species in Nebraska and one of the most widely distributed. Individuals occur in every major terrestrial habitat with the exception of dense woods and low, marshy places but the species usually is commonest in upland habitats having a moderate cover of grasses or weeds. In areas devoted mainly to cultivation of crops *P. maniculatus* finds homesites in fallow fields and along fencerows, especially those bordering roads, where it sometimes is the only species of small mammal trapped.

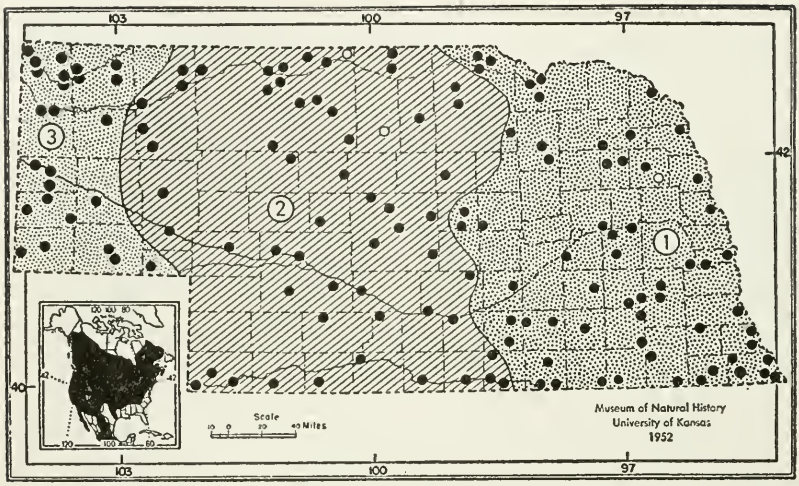

FIG. 42. Distribution of *Peromyscus maniculatus* in Nebraska. 1. *P. m. bairdii.* 2. *P. m. luteus.* 3. *P. m. nebrascensis.* For explanation of symbols see Fig. 5.

Geographic variation in *P. maniculatus* in Nebraska is marked, both in size and in color of upper parts, the latter seemingly correlated with the color of soil on which the mice live (see Fig. 4). Three distinct subspecies are found in the state, *P. m. bairdii* in the east, *P. m. luteus* on the Sand Hills and adjacent areas in the central part, and *P. m. nebrascensis* on the Pine Ridge and elsewhere in the Panhandle. *P. m. bairdii* is the smallest of the three and typically has blackish or dark brown upper parts; *P. m. luteus* averages slightly larger than *bairdii* and is the palest of the three, typically having upper parts of bright ochraceous-buff; *P. m. nebrascensis* is the largest and typically has buffy gray upper parts. Thus, *bairdii* differs from *luteus* more in color than in size, whereas *luteus* differs from *nebrascensis* more in size than in color. Dice (1941) previously studied variation in the deer mouse in Nebraska and my findings are more or less in accord with his.

The deer mouse breeds at least throughout the warmer parts of the year in Nebraska. Sixty-two pregnant females collected in the months of March through November carried an average of 4.5 (2-9) embryos; the mode was 5.

Peromyscus maniculatus bairdii (Hoy and Kennicott)

Mus bairdii Hoy and Kennicott, Exec. Doc., House of Representatives, 3rd Sess., 34th Cong. (Rept. of Comm. Patents for 1856), 65:92, 1857 (type locality restricted to Bloomington, McLean Co., Illinois, by Osgood, N. Amer. Fauna, 28:79, April 17, 1909).

Peromyscus maniculatus bairdi, Osgood, N. Amer. Fauna, 28:79, April 17, 1909; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Whelan, Trans. Kansas Acad. Sci., 39:366, 1937.

H[esperomys]. Michiganensis, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Peromyscus michiganensis, Swenk, Proc. Nebraska Acad. Sci., 8:95, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:39, September, 1908.

Peromyscus maniculatus bairdii, Dice, Contrib. Lab. Vert. Genetics, Univ. Michigan, 15:16, July, 1941; Bole and Moulthrop, Sci. Publ. Cleveland Mus. Nat. Hist., 5:144, September 11, 1942; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949; Hall and Kelson, The mammals of North America, p. 618, March 31, 1959; Jones, Jour. Mamm., 41:132, February 20, 1960; Galbreath, Trans. Kansas Acad. Sci., 64:226, November 1, 1961.

P[eromyscus]. m[aniculatus]. bairdii, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Eastern part of state, west certainly to Adams, Boyd, and Valley counties. See Fig. 42.

External measurements.—Average and extreme measurements of 17 specimens (nine males, seven females, one of unknown sex) from Richardson County are: 147.5 (125-164); 58.5 (43-66); 18.7 (16-20); 14.0 (13-15). For cranial measurements see Table 14.

Eight specimens (three males, five females) from the above-mentioned series weighed an average of 21.4 (20.0-24.0) grams.

Remarks.—For comparison with *Peromyscus maniculatus luteus,* geographically adjacent to the west in Nebraska, see account of that subspecies.

Specimens of *P. m. bairdii* from southeastern Nebraska do not differ in color of upper parts or in size when compared with specimens from Iowa and Illinois and are regarded as typical of the subspecies. On the other hand, specimens from the western and, to a lesser extent, northern parts of the range of *bairdii* in Nebraska average variously paler in color of upper parts than do typical specimens and thereby are intergrades with *P. m. luteus.* For example: eight of 11 adults from Saronville approach *bairdii* in color whereas three are intermediate between *bairdii* and *luteus;* among 15 specimens from 10 mi. S Ord, none is so dark as typical *bairdii* but none is so pale as typical *luteus* and the average is nearer *bairdii* than *luteus;* and of five skins from 1 mi. SW Neligh, three approach *bairdii* from southeastern Nebraska, one is noticeably paler than *bairdii* but nearer it than *luteus,* and the fifth approaches *luteus.* Many specimens from northeastern Nebraska are slightly paler than typical *bairdii,* having upper parts that are dark brown but that lack a suffusion of blackish.

The zone of intergradation between *bairdii* and *luteus* is broad. Most intergrades can be readily assigned on the basis of color of

upper parts to one subspecies or the other but in a few instances assignment of individuals is difficult and necessarily made on geographic grounds.

To the north of the Niobrara River intergrades from Boyd County are adjudged nearer *bairdii* than *luteus;* specimens from adjacent parts of South Dakota also have been described as resembling *bairdii* in color (Dice, 1941:8-9). Farther to the west on the tablelands north of the Niobrara intergrades from Keya Paha County and northeastern Cherry County are assignable to *luteus.*

Records of occurrence.—Specimens examined, 438, as follows: ADAMS COUNTY: 4 mi. N, 2 mi. E Hastings, 5 (UNM); *1 mi. N, 3½ mi. E Hastings,* 3 (UNM); *Hastings,* 2 (NSM); 10 mi. S Hastings, 7 (UNM); *no specific locality,* 23 (HM). ANTELOPE COUNTY: 1 mi. SW Neligh, 10; Oakdale, 2 (NSM). BOYD COUNTY: 5 mi. WNW Spencer, 1; 4 mi. N Bristow, 5; *Spencer,* 1 (UNDZ); 5 mi. S, 2 mi. E Spencer, 4; *6 mi. SSE Spencer,* 2. BURT COUNTY: 1 mi. E Tekamah, 1. BUTLER COUNTY: 4 mi. N, ½ mi. E Octavia, 3 (2 NSM); 2 mi. N, 2 mi. W Bellwood, 1 (NSM); 4-5 mi. E Rising City, 9; *4 mi. S, 4 mi. W David City,* 1; *4 mi. E, 1 mi. S Rising City,* 2; *5 mi. SW Garrison,* 1 (UNDZ). CLAY COUNTY: Saronville, 12 (UF). CUMING COUNTY: 1 mi. S Beemer, 1. DIXON COUNTY: 3 mi. NE Ponca, 3. FILLMORE COUNTY: Geneva, 3 (NSM). GAGE COUNTY: ¼ mi. W Homestead Nat'l Mon., 1; Barnston, 1 (NSM); *1 mi. S, 1 mi. W Barnston,* 1; *1½ mi. S, 2 mi. E Barnston,* 16; *2 mi. S, 1 mi. E Barnston,* 1. GREELEY COUNTY: 1 mi. W Scotia, 2 (NGFPC). HALL COUNTY: Grand Island, 1 (USNM); *6 mi. S Grand Island,* 11. HOLT COUNTY: *6 mi. N Midway,* 6; Ewing, 1 (USNM). JEFFERSON COUNTY: 7 mi. S, 2 mi. W Fairbury, 5; *3 mi. S, 1 mi. W Endicott,* 16. JOHNSON COUNTY: 1 mi. S, 1½ mi. E Burr, 2. KNOX COUNTY: *3 mi. W Niobrara,* 4; *W side Niobrara State Park,* 2 (NGFPC); 1-1½ mi. SE Niobrara, 11 (1 NGFPC); *2-2½ mi. S Niobrara,* 2 (1 NGFPC); 8 mi. SW Niobrara, 1 (NGFPC); Verdigre, 1 (USNM). LANCASTER COUNTY: *12 mi. N Lincoln,* 4 (UC); 9 mi. N Lincoln, 8 (UMMZ); *8 mi. N Lincoln,* 1 (UC); *8-9 mi. NW Lincoln,* 4 (3 NGFPC); within 5 mi. Lincoln, 45 (6 CNHM, 1 NGFPC, 15 UC, 6 UNDZ, 12 NSM). NEMAHA COUNTY: 3 mi. SW Peru, 1; *3 mi. S, 1½ mi. E Peru,* 2; London, 5 (NSM). NUCKOLLS COUNTY: 5 mi. N, ½ mi. E Nelson, 3 (UNM); 2 mi. WSW Superior, 5; 1 mi. SSW Hardy, 2. OTOE COUNTY: 3 mi. S, 2 mi. E Nebraska City, 2. PAWNEE COUNTY: NW of Pawnee City, 5 (NGFPC); 4 mi. S, 8 mi. W Pawnee City, 14. PLATTE COUNTY: 2 *mi. N Columbus,* 1 (UNDZ); 6 mi. S Monroe, 1 (UC); Columbus, 3 (USNM); *3½ mi. E Columbus,* 1 (UNDZ); *3 mi. S Columbus,* 1 (CNHM). POLK COUNTY: 15 mi. W Osceola, 2. RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 2 (1 NSM); 4 mi. E Barada, 9; 3½ mi. S, 1 mi. W Dawson, 9; 2 mi. N Falls City, 9; *4-6 mi. W Falls City,* 6; *8 mi. S, 1 mi. E Dawson,* 4; 3 mi. S Rulo, 1. SALINE COUNTY: 2 mi. NE Crete, 1; ½ mi. W De Witt, 1. SARPY COUNTY: Fort Crook, 3 (AMNH); *2 mi. ESE La Platte,* 14; 1 mi. W Meadow, 1. SAUNDERS COUNTY: 2 mi. NW Ashland, 2. SEWARD COUNTY: 1 mi. N Pleasant Dale, 2; Milford, 1 (UNDZ). STANTON COUNTY: 1½ mi. S Pilger, 11; 8 mi. SE Norfolk, 1. THAYER COUNTY: 6 mi. E Hubbell, 2 (CNHM). THURSTON COUNTY: ¾ mi. E Winnebago, 1; *1 mi. S Winnebago,* 7. WASHINGTON COUNTY: *Blair,* 13 (UMMZ); 1 mi. E Blair, 2; *3 mi. SE Blair,* 1; *6 mi. SE Blair,* 2. WAYNE COUNTY: 2½ mi. E Wayne, 2; 4 mi. W Hoskins, 10. VALLEY COUNTY: 4 mi. E, 2 mi. S Ord, 5; 10 mi. S Ord, 15 (NGFPC). YORK COUNTY: Waco, 4 (1 NSM, 3 UMMZ).

Additional records: CLAY COUNTY: Inland (Swenk, MS). CUMING COUNTY: West Point (Swenk, MS).

Peromyscus maniculatus luteus Osgood

Peromyscus luteus Osgood, Proc. Biol. Soc. Washington, 18: 77, February 21, 1905 (type locality, Kennedy, Cherry Co., Nebraska). Warren, Colorado Coll. Publ., Engin. Ser., 1:74, January, 1908; Swenk, Proc. Nebraska Acad. Sci., 8:95, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:39, September, 1908 (part); Lyon and Osgood, Bull. U. S. Nat. Mus., 62:133, January 28, 1909.

Peromyscus maniculatus luteus, Osgood, N. Amer. Fauna, 28:77, April 17, 1909; Warren, The mammals of Colorado . . ., p. 132, 1910; Cary, N. Amer. Fauna, 33:103, August 17, 1911; Jones, Proc. Biol. Soc. Washington, 71:110, July 16, 1958; Hall and Kelson, The mammals of North America, p. 1081, March 31, 1959 (part, see also p. 622); Jones and Mursaloğlu, Proc. Biol. Soc. Washington, 74:102, May 19, 1961.

Hesperomys sonoriensis, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):474, July 14, 1858.

Hesperomys leucopus sonoriensis, Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:79, August, 1877.

H[esperomys]. sonariensis [sic], Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Peromyscus texanus nebrascensis, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:251, November, 1896.

Peromyscus texensis nebrascensis, Elliot, Field Columb. Mus., Zool. Ser. (Publ. 115), 8:220, 1907.

Peromyscus maniculatus nebrascensis, Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Clark, Jour. Mamm., 17:45, February 14, 1936; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Dice, Contrib. Lab. Vert. Genetics, Univ. Michigan, 15:1, July, 1941; Poole and Schantz, Bull. U. S. Nat. Mus., 178:324, April 9, 1942; Warren, The mammals of Colorado . . ., p. 203, 1942; Lindeborg, Contrib. Lab. Vert. Biol., Univ. Michigan, 58:3, June, 1952; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:338, May 12, 1958; Hall and Kelson, The mammals of North America, p. 622, March 31, 1959 (part).

Peromyscus m[aniculatus]. nebrascensis, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Peromyscus maniculatus, Jones, Nebraska Bird Rev., 20:10, January, 1952.

P[eromyscus]. m[aniculatus]. nebrascensis, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Sand Hills and adjacent areas of central part of state, east certainly to Holt and Webster counties, west certainly to Garden and Sheridan counties. See Fig. 42.

External measurements.—Average and extreme measurements of 30 adults (15 males, 15 females) from eastern Cherry County are: 147.9 (130-164); 59.6 (50-72); 19.3 (18-20); 14.5 (13-15). For cranial measurements see Table 14.

Two females from Cherry County weighed 19.1 and 18.2 grams. Twelve males from the vicinity of Franklin weighed an average of 21.1 (18.7-24.9) grams.

Remarks.—From *Peromyscus maniculatus bairdii,* geographically adjacent to the east in Nebraska, *P. m. luteus* differs in being

slightly larger (see measurements), but especially in having decidedly paler upper parts (ochraceous buff rather than blackish brown). From *Peromyscus maniculatus nebrascensis,* geographically adjacent to the west in Nebraska, *P. m. luteus* differs in being somewhat paler (ochraceous buff rather than buffy gray), but especially in being smaller, both externally and cranially (see measurements), although there is some overlap in all measurements I have analyzed. The most useful single measurement in separating *luteus* from *nebrascensis* seems to be length of ear from notch, which in the former is usually 15 or less and in the latter usually 16 or more.

Peromyscus maniculatus luteus is the name currently applied to the small, pale-colored deer mice on the eastern part of the Great Plains from western North Dakota south to western Oklahoma. For many years the name *P. m. nebrascensis* was applied to these mice because its type locality was thought to be in Nebraska. Actually, the type locality of *nebrascensis* is in Wyoming (see Jones, 1958*b*), well within the geographic range of the subspecies formerly designated as *P. m. osgoodi.* Consequently, *nebrascensis* replaced *osgoodi* and *luteus,* formerly in synonymy under *nebrascensis,* became the valid name for the eastern population on the Great Plains.

Specimens of *luteus* from localities on the Sand Hills of Nebraska are paler on the average than specimens from elsewhere in the range of the subspecies. Even so, specimens of *luteus* from other places (both in Nebraska and neighboring states) are decidedly paler than *bairdii* and are less grayish and markedly smaller than *nebrascensis.* Of note is the fact that, despite the paleness of most specimens, some individuals in every series from the Sand Hills are darker (more grayish or brownish or both) than typical specimens and approach in color either *nebrascensis* or intergrades between *luteus* and *bairdii.* Dice (1941:18) suggested that this variation was "probably due in considerable part to constant interbreeding with the darker-colored populations which surround the sand hills on every side."

Specimens from all along the eastern part of the range of *P. m. luteus* in Nebraska are intergrades with *P. m. bairdii;* especially notable in this regard are specimens examined from Keya Paha, Rock, Holt, Custer, Buffalo, and Webster counties. A series of 25 specimens from Comstock illustrates the point. Eight of the 25 resemble typical *luteus,* three would, standing alone, be referred to *bairdii,* while the remaining specimens are intermediate in color

between the two subspecies but on the average resemble *luteus* to a greater degree than *bairdii*. Specimens from the western edge of the range of *luteus*, which more or less coincides with the western edge of the Sand Hills, are intergrades with *nebrascensis*. To the north, in northwestern Cherry County and adjacent Sheridan County, some specimens referable to *luteus* tend to resemble *nebrascensis* in color of upper parts but are typical of *luteus* in size. Conversely, specimens from more southern localities, Garden and Dundy counties for example, resemble *luteus* in color but some approach *nebrascensis* in size; this is illustrated especially among specimens in the series examined from 5 mi. N and 2 mi. W Parks.

Records of occurrence.—Specimens examined, 637, as follows: BUFFALO COUNTY: 1 mi. E Ravenna, 5 (UMMZ); Elm Creek, 1 (NSM). CHERRY COUNTY: W of Crookston, 12 (NSM); Valentine, 5 (2 UMMZ, 2 UNDZ, 1 USNM); *Ft. Niobrara Nat'l Wildlife Refuge, 4 mi. E Valentine,* 21; *Ft. Niobrara Nat'l Wildlife Refuge,* 8 (NSM); 3 mi. SSE Valentine, 4; 8 mi. S Nenzel, 4; 10 mi. E Gordon, 4 (CNHM); Niobrara River, 10 mi. S Cody, 6 (2 NSM, 4 USNM); *11 mi. S, 2 mi. W Nenzel,* 1; *12 mi ESE Gordon,* 5 (CNHM); 18 mi. NW Kennedy, 6 (2 NSM, 4 USNM); Two Mile Lake (sec. 12, T. 31 N, R. 34 W), 2 (1 NSM, 1 USNM); *Snake River,* 1 (USNM); *Watt's Lake, Valentine Nat'l Wildlife Refuge,* 3 (UC); *½ mi. W Headquarters, Valentine Nat'l Wildlife Refuge,* 2 (UC); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 18 (9 UMMZ, 1 UNDZ); *Rice Lake, Valentine Nat'l Wildlife Refuge,* 1 (NGFPC); *Pelican Lake, Val. Nat'l Wildlife Refuge,* 3 (UC); *Valentine Nat'l Wildlife Refuge,* 1 (NSM); Kennedy, 23 (3 UMMZ, 20 USNM); *2-4 mi. E Kennedy,* 26; *11 mi. E Kennedy,* 4; Pony Lake, Valentine Nat'l Wildlife Refuge, 1 (NGFPC); 30 mi. S Wood Lake, 1 (CNHM); North Fork, Middle Loup River, NW of Mullen, 6 (NSM); *no specific locality,* 12 (USNM). CUSTER COUNTY: 1-4 mi. NW Gavin, 6 (UMMZ); within ½ mi. Victoria Springs, 5 (UMMZ); Comstock, 27 (2 AMNH, 25 NSM); Broken Bow, 1 (USNM); Callaway, 9 (USNM); 6 mi. SE Mason City, 1 (UMMZ). DAWSON COUNTY: ½ mi. S Gothenburg, 1; *3 mi. ESE Gothenburg,* 5; *5 mi. S Gothenburg,* 6. DUNDY COUNTY: Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, 51 (5 NGFPC); Benkelman, 2 (WFR); *2 mi. N, 2 mi. W Haigler,* 3; *Arikaree River, Parks,* 5; *2 mi. SW Benkelman,* 5; Haigler, 10 (2 NSM, 8 USNM). FRANKLIN COUNTY: 1 mi. SE Franklin, 3; *2 mi. S Franklin,* 11. FRONTIER COUNTY: 3 mi. N Curtis, 1 (UC). FURNAS COUNTY: 5 mi. W Holbrook, 5 (UI). GARDEN COUNTY: Crescent Lake, 1 (USNM); ½ mi. S Oshkosh, 5; *Windlass Hill (2 mi. SE Lewellen),* 2. GARFIELD COUNTY: 10 mi. N Burwell, 1 (UNM). GOSPER COUNTY: 6 mi. N Elwood, 2 (NSM). HARLAN COUNTY: 1 mi. W Alma, 4; *1 mi. S Alma,* 1. HITCHCOCK COUNTY: 8 mi. S, 3 mi. W Trenton, 6. HOLT COUNTY: 10 mi. NE Stuart, 2 (NSM); 1 mi. S Atkinson, 10 (5 NSM). HOOKER COUNTY: Kelso, 10 (UMMZ). KEARNEY COUNTY: 1¾-3¾ mi. S Kearney, 5. KEITH COUNTY: 4 mi. WNW Keystone, 85. KEYA PAHA COUNTY: 10-12 mi. N Springview, 6; *12 mi. NNW Springview,* 9; Springview, 2 (NSM). LINCOLN COUNTY: Birdwood Creek, 8 mi. N, 4 mi. W Hershey, 2; 2 mi. N, 5 mi. W North Platte, 2; secs. 9 and 14, T. 11 N, R. 27 W (approximately 6 mi. S, 2 mi. W Brady), 4 (NSM); *near Brady,* 3 (NSM); 6 mi. NE Dickens, 1 (UMMZ). LOGAN COUNTY: 1-2 mi. NE Stapleton, 47. RED WILLOW COUNTY: 8 mi. S, 3 mi. E McCook, 2. ROCK COUNTY: Perch, 13 (11 AMNH, 2 CNHM). SHERIDAN COUNTY: Gordon, 5 (NSM); 11 mi. S Gordon, 9; Mirage Twp., 2 (UMMZ); 16 mi. NE Alliance, 7 (UMMZ); 5 mi. N Antioch, 1 (UMMZ). THOMAS COUNTY: *1-4 mi. W Halsey,* 13; Halsey, 10 (6 AMNH, 1 NSM, 3 USNM); *Nebraska Nat'l Forest,* 3 (NGFPC); *no specific locality,* 1 (USNM). WEBSTER COUNTY: Bladen, 14 (HM); ½ mi. E, 2 mi. N Inavale, 2 (NSM); *Red Cloud,* 1 (NSM); 3 mi. S Red Cloud, 1.

Additional records: BROWN COUNTY: 22 mi. S Ainsworth (specimen catalogued in CNHM, but not now to be found). CHERRY COUNTY: 1½ mi. W Sparks (Dice, 1941:6); *Center Lake, Valentine Nat'l Wildlife Refuge* (Jones, 1952:10). FURNAS COUNTY: *no specific locality* (Rapp and Gates, 1957:53). KEARNEY COUNTY: *Ft. Kearney* (Coues, *in* Coues and Allen, 1877:82). LINCOLN COUNTY: *North Platte* (Swenk, MS). County unknown: *Englemann Creek, Republican River* (Baird, 1858:476); *Republican River* and *Platte River* (Coues, *in* Coues and Allen, 1877:82).

Peromyscus maniculatus nebrascensis (Coues)

Hesperomys sonoriensis var. *nebrascensis* Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:79, August, 1877 (type locality restricted to Deer Creek, approximately five miles from its mouth, Converse Co., Wyoming, by Jones, Proc. Biol. Soc. Washington, 71:108, July 16, 1958, and others).

Peromyscus maniculatus nebrascensis, Osgood, N. Amer. Fauna, 28:75, April 17, 1909; Sprague, Trans. Kansas Acad. Sci., 42:487, 1939; Quay, Jour. Mamm., 29:181, May 14, 1948; Jones, Proc. Biol. Soc. Washington, 71:109, July 16, 1958; Hall and Kelson, The mammals of North America, p. 1081, March 31, 1959 (part, see also p. 622); Jones and Mursaloğlu, Proc. Biol. Soc. Washington, 74:102, May 19, 1961.

Peromyscus texianus nebrascensis, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Peromyscus luteus, Swenk, Proc. Nebraska Acad. Sci., 8:95, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:39, September, 1908 (part).

Peremyscus [sic] nebrascensis, Swenk, Proc. Nebraska Acad. Sci., 8:96, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:40, September, 1908.

Peromyscus maniculatus osgoodi, Swenk, Bull. Agric. Exp. Sta., Univ. Nebraska, 154:29, August 15, 1915; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:485, April 21, 1954; Hall and Kelson, The mammals of North America, p. 622, March 31, 1959 (part).

P[eromyscus]. m[aniculatus]. osgoodi, Dice, Contrib. Lab. Vert. Genetics, Univ. Michigan, 15:1 (see especially p. 17), July, 1941; Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Panhandle, excluding Sand Hills, east at least to Dawes and Deuel counties. See Fig. 42.

External measurements.—Average and extreme measurements of 30 specimens (17 males, 13 females) from northeastern Sioux County are: 160.7 (151-177); 63.6 (52-77); 19.9 (18-21); 16.5 (15-19). For cranial measurements see Table 14.

Weight in grams of 26 specimens from the above-mentioned series averaged 25.0 (19.8-27.9).

Remarks.—For comparison with *Peromyscus maniculatus luteus,* geographically adjacent to the east in Nebraska, see account of that subspecies.

The characters of *P. m. nebrascensis* are best developed in Nebraska in specimens from the Pine Ridge and adjacent areas in Sioux and Dawes counties; mice from there are inseparable from specimens from the type locality. Specimens from most localities

to the south of the Pine Ridge, especially from the southwestern part of the Panhandle, approach *P. m. luteus* in color of upper parts but are typical of *nebrascensis* in size and are referred to the latter.

Swenk (1908:95-96) was the first author to recognize the occurrence of three distinct kinds of deer mice in Nebraska although his assignment of some specimens was incorrect. Osgood (1909) did not record *P. m. nebrascensis* from the state although he examined (and properly identified to species on the specimen label) a specimen in the Carnegie Museum from the head of Warbonnet Creek, Sioux County. Probably this was the specimen that he (*op. cit.*:124) listed under *Peromyscus leucopus aridulus.*

Records of occurrence.—Specimens examined, 347, as follows: BANNER COUNTY: 9 mi. N, 5 mi. E Harrisburg, 3; 10 mi. W Harrisburg, 6 (NSM); *15 mi. SW Harrisburg,* 1 (NSM); 8 mi. SW Redington, 1 (NSM). BOX BUTTE COUNTY: near Hemingford, 3 (NSM). CHEYENNE COUNTY: 15 mi. S Dalton, 4300 ft., 10; *3 mi. N Sidney, 4250 ft.,* 1; 4 mi. E Sidney, 14. DAWES COUNTY: Chadron, 12 (6 CSTC, 6 NSM); *3 mi. E Chadron,* 2; Sand Creek, NE of Horn, 6 (NSM); *6-8 mi. S Chadron,* 10 (NSM); *Chadron State Park,* 5 (4 NGFPC, 1 NSM); 10 mi. S Chadron, 24 (UMMZ); *Ft. Robinson,* 1; *1-3 mi. W Crawford,* 8 (NSM); Crawford, 8 (5 NSM, 3 UMMZ); *1 mi. S Crawford,* 2 (RV); *3 mi. SW Crawford,* 1. DEUEL COUNTY: 1 mi. N, 2 mi. W Chappell, 4. KIMBALL COUNTY: 3 mi. E Kimball, 14; Smeed, 10. MORRILL COUNTY: Courthouse Rock, 1 (NSM). SCOTTS BLUFF COUNTY: *8 mi. NNW Scottsbluff,* 3; Mitchell, 1 (NSM); *½-1 mi. S Mitchell,* 4; Scottsbluff, 13 (1 AMNH, 12 HM); *5 mi. S Gering,* 5; 10-11 mi. S Scottsbluff, 4300-4600 ft., 3; *12 mi. SSW Scottsbluff, 4700 ft.,* 5. SIOUX COUNTY: 20 mi. NW Harrison, 2 (WSC); 1 mi. S, 4 mi. W Orella, 29 (NSM); Squaw Canyon, 1 (CM); *head Warbonnet Creek,* 1 (CM); *Warbonnet Canyon,* 12 (NSM); *8-9 mi. N Harrison,* 2 (UMMZ); *5½ mi. N, 2½ mi. W Harrison,* 4 (NGFPC); Monroe Canyon, 4 mi. N, 2 mi. W Harrison, 4 (NSM); *Monroe Canyon,* 8 (3 NGFPC, 1 NSM, 4 UNDZ); *4 mi. N, 1½ mi. W Harrison,* 1 (NGFPC); *West Monroe Canyon,* 1 (NSM); 10 mi. W, 1½ mi. N Crawford, 10 (8 NSM); *5½-7 mi. W Crawford,* 21 (16 NSM); *3½ mi. N, 1 mi. E Glen,* 34 (NSM); *3 mi. N Glen,* 2 (NSM); Glen, 23, (NSM); Agate, 4600 ft., 6 (1 CNHM, 4 UMMZ); *3 mi. E Agate,* 4; 8 mi. E Agate, 1 (NSM).

Onychomys leucogaster

Northern Grasshopper Mouse

The northern grasshopper mouse is a common inhabitant of western Nebraska where in my experience it is most frequently taken along the borders of little-used roads and upland grain fields and in relatively undisturbed upland prairie. The species occurs also in most of eastern Nebraska but is rare, probably because most of the original upland prairie there has been turned for agricultural purposes—although this cricetid may never have been common on the tall-grass prairie of the eastern part of the state. The Missouri River and its deciduous riparian association evidently present an effective barrier to eastward dispersal of this grasshopper mouse at

the latitude of Nebraska. Farther to the north in South Dakota, this barrier is breached and *O. leucogaster* occurs on the eastern side of the Missouri in southeastern South Dakota and even reaches northwestern Iowa (see Hall and Kelson, 1959:664, map 380).

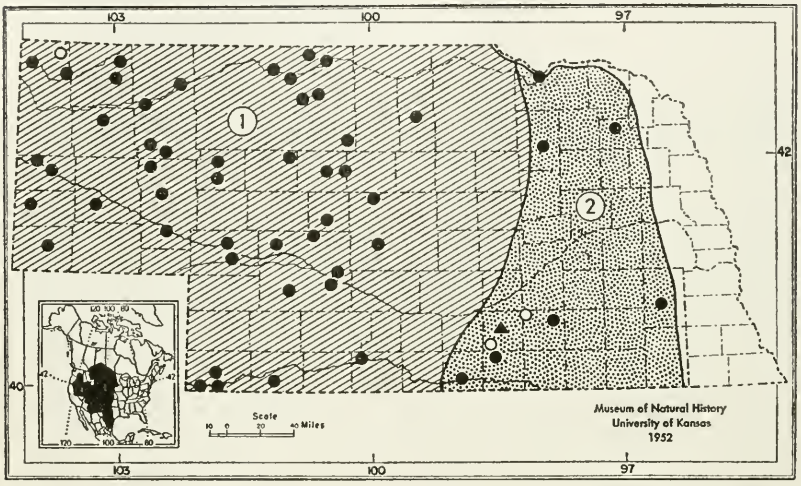

FIG. 43. Distribution of *Onychomys leucogaster* in Nebraska. 1. *O. l. arcticeps*. 2. *O. l. breviauritus*. For explanation of symbols see Fig. 5.

In summer *O. leucogaster* is largely carnivorous (mostly arthropods), possibly accounting for the fact that members of the species show a predilection for home-sites along road-sides and the borders of grain fields. Despite the preference for animal food, the northern grasshopper mouse is not difficult to trap in summer using conventional baits such as rolled oats. In winter food probably consists mostly of grain and seeds of native weeds and grasses. Hollister (1914) reviewed the systematics of grasshopper mice and Bailey and Sperry (1929) wrote on their life history.

The northern grasshopper mouse, like other Nebraskan cricetids, is polyestrous. Nine pregnant females from the months of April, June (three), July (three), and August (two) carried an average of 4.7 (3-8) embryos.

Onychomys leucogaster arcticeps Rhoads

Onychomys arcticeps Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 50:194, May 3, 1898 (type locality, Clapham, Union Co., New Mexico).

Onychomys leucogaster arcticeps, Hollister, Proc. U. S. Nat. Mus., 47:439, October 29, 1914; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Beed, Bull. Conserv. Surv.

Div., Univ. Nebraska, 10:21, October, 1936; Hall and Kelson, The mammals of North America, p. 662, March 31, 1959.

Hesperomys (Onychomys) leucogaster, Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:108, August, 1877.

H[esperomys]. leucogaster, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Onychomys leucogaster, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:253, November, 1896; Cary, Proc. Nebraska Ornith. Union, 3:65, December, 1902; Elliot, Field Columb. Mus., Zool. Ser. (Publ. 115), 8:200, 1907; Swenk, Proc. Nebraska Acad. Sci., 8:93, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:37, September, 1908 (part); Jones, Nebraska Bird Rev., 20:10, January, 1952.

Onychomys leucogaster pallescens, Swenk, Proc. Nebraska Acad. Sci., 8:93, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:37, September, 1908 (part).

Onychomys leucogaster articeps [sic], Swenk, Nebraska Blue Book, p. 480, December, 1920.

Onychomys l[eucogaster]. arcticeps, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

O[nychomys]. l[eucogaster]. arcticeps, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Western half of state, east certainly to Custer and Rock counties. See Fig. 43.

External measurements.—Average and extreme measurements of 13 specimens (eight males, five females) from Kimball and Logan counties are: 140.5 (135-146); 39.8 (37-44); 20.8 (20-21); 15.3 (14-17). Corresponding measurements of five specimens (three males, two females) from Cherry County are: 151.6 (147-159); 39.8 (36-42); 21.0 (20-22); 16.0 (15-17, three specimens). For cranial measurements see Table 14.

A male and female from 2 mi. E Kennedy weighed 40.9 and 34.0 grams, respectively. Two males from Sioux County weighed 43.2 and 35.4 grams.

Remarks.—From *Onychomys leucogaster breviauritus,* geographically adjacent to the east in Nebraska, *O. l. arcticeps* differs principally in having paler upper parts (pale grayish rather than sooty in juveniles, pale brownish gray rather than grayish black in summer-taken adults, buffy brown lightly washed with pinkish rather than dark brown in winter-taken adults). Additionally, *O. l. arcticeps* averages slightly smaller than *O. l. breviauritus,* usually has a whitish rather than a cinnamon-buff tuft at the base of the ear, and may have a large area of white terminally on the tail.

Of the specimens herein assigned to *arcticeps* the four from Callaway average darker than typical specimens and are regarded as intergrades with *breviauritus.* When specimens from Cherry County taken in the same season are compared with those from Callaway, the darkest can be matched by the palest from the latter locality.

Records of occurrence.—Specimens examined, 257, as follows: BANNER COUNTY: 10 mi. W Harrisburg, 1 (NSM). BOX BUTTE COUNTY: near Hemingford, 1 (NSM). CHERRY COUNTY: W of Crookston, 1 (NSM); *Ft. Niobrara Nat'l Wildlife Refuge,* 1 (NSM); *Valentine,* 24 (1 NSM, 23 USNM); *Niobrara River, Clark's Canyon, near Valentine,* 1 (USNM); 10 mi. S Cody, 2 (USNM); 18 mi. NW Kennedy, 5 (2 NSM, 3 USNM); *Snake River,* 1

(USNM); *Watt's Lake, Valentine Nat'l Wildlife Refuge,* 3 (UC); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 22 (18 UMMZ); 2 mi. W to 4 mi. E Kennedy, 7 (1 UMMZ, 2 USNM); *Valentine Nat'l Wildlife Refuge,* 1 (NSM); 30 mi. S Woodlake, 4 (CNHM); *no specific locality,* 14 (USNM). CHEYENNE COUNTY: *15 mi. S Dalton, 4300 ft.,* 8. CUSTER COUNTY: *1-4 mi. NW Gavin,* 12 (1 MVZ, 11 UMMZ); 7 mi. NW Anselmo, 4 (UMMZ); Callaway, 4 (USNM). DAWES COUNTY: 3 mi. E Chadron, 3; *Chadron State Park,* 2 (NGFPC); 10 mi. S Chadron, 1 (UMMZ); *1 mi. W Crawford,* 1 (NSM). DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 5; 1 mi. S Parks, 1; Haigler, 5 (USNM). FURNAS COUNTY: 5 mi. W Holbrook, 3 (UI). GARDEN COUNTY: 10 mi. S Antioch, 5 (UMMZ); Crescent Lake Nat'l Wildlife Refuge, 1 (USNM); 2 mi. S Oshkosh, 1. GRANT COUNTY: Hyannis, 2 (UMMZ); 13 mi. S Hyannis, 2 (CNHM). HITCHCOCK COUNTY: 8 mi. S, 3 mi. W Trenton, 1. HOOKER COUNTY: Kelso, 5 (UMMZ). KEITH COUNTY: 4 mi. WNW Keystone, 4; 1-4 mi. N, 7 mi. E Ogallala, 5. KIMBALL COUNTY: 3 mi. E Kimball, 7. LINCOLN COUNTY: Myrtle, 2 (USNM); Birdwood Creek, 8 mi. N, 4 mi. W Hershey, 2950 ft., 3; *Birdwood Creek,* 2 (USNM); NW corner sec. 2, T. 12 N, R. 27 W (1½ mi. N Brady), 1 (NSM); sec. 9, T. 11 N, R. 27 W (5½ mi. S, 2 mi. W Brady), 2 (NSM); 6 mi. NE Dickins, 1 (UMMZ); *no specific locality,* 3 (USNM). LOGAN COUNTY: 2 mi. NE Stapleton, 7. MORRILL COUNTY: 6 mi. S Bridgeport, 2 (MVZ). ROCK COUNTY: Perch, 18 (17 AMNH, 1 CNHM). SCOTTS BLUFF COUNTY: Mitchell, 8 (NSM); Scottsbluff, 1 (HM). SHERIDAN COUNTY: 12 mi. S Gordon, 6 (MVZ); 16 mi. NE Alliance, 4 (UMMZ); 4-8 mi. N Antioch, 8 (UMMZ); Lakeside, 4 (USNM). SIOUX COUNTY: Warbonnet Canyon, 4 (NSM); 5½-7 mi. W Crawford, 3 (NSM). THOMAS COUNTY: 10 mi. W Halsey, 1 (UMMZ); Halsey, 1 (USNM); *1 mi. S, 3½ mi. W Halsey,* 1; *Nebraska Nat'l Forest,* 1 (NGFPC); *no specific locality,* 4 (USNM).

Additional record: SIOUX COUNTY: Orella (Jones, 1949*b*:5).

Onychomys leucogaster breviauritus Hollister

Onychomys leucogaster breviauritus Hollister, Proc. Biol. Soc. Washington, 26:216, December 20, 1913 (type locality, Ft. Reno, Canadian Co., Oklahoma); Hollister, Proc. U. S. Nat. Mus., 47:453, October 29, 1914; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Miller and Kellogg, Bull. U. S. Nat. Mus., 205:517, March 3, 1955; Hall and Kelson, The mammals of North America, p. 663, March 31, 1959.

Onychomys leucogaster, Swenk, Proc. Nebraska Acad. Sci., 8:93, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:37, September, 1908 (part).

O[nychomys]. l[eucogaster]. breviauritus, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Eastern part of state except eastern edge, west certainly to Antelope and Franklin counties. See Fig. 43.

External measurements.—Average and extreme measurements of eight specimens (five males, three females) from Antelope and Knox counties are: 148.0 (140-158); 42.0 (38-46); 21.8 (20.5-22.5); 17.0[3] (17). Measurements of a male from Saronville followed by a male from 2 mi. S Franklin are: 163, 163; 44, 50; 23, 23; —, 20. For cranial measurements see Table 14.

Remarks.—For comparison with *Onychomys leucogaster arcticeps,* see account of that subspecies.

Specimens from the northwestern part of the range of *O. l. breviauritus* in Nebraska (Antelope and Knox counties) average smaller

TABLE 14.—CRANIAL MEASUREMENTS OF THREE GENERA OF CRICETINES.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Zygomatic breadth	Interorbital constriction	Length of rostrum	Length of incisive foramen	Depth of skull	Length of maxillary tooth-row
Reithrodontomys megalotis dychei, Cherry County							
Average 20 (14♂, 6♀)	21.0	10.9	3.1	7.3	4.4	7.9	3.5
Minimum	20.4	10.0	2.9	6.8	4.3	7.5	3.2
Maximum	22.1	11.3	3.3	7.8	4.7	8.4	3.7
Reithrodontomys montanus albescens, type locality							
116354 USNM, ♂	19.5	10.3	3.1	6.5	3.9	7.7	3.5
116358 USNM, ♂ (type)	19.8	10.1	3.0	6.7	4.2	7.6	3.3
116359 USNM, ♀	19.7	10.3	3.1	6.9	4.1	7.5	3.5
3¾ mi. S Kearney, in Kearney County							
69052 KU, ♂	19.5	10.4	2.8	6.5	3.7	7.5	3.4
69053 KU, ♂	19.2	10.3	2.9	6.5	4.0	7.3	3.5
69054 KU, ♂	19.0	10.8	2.9	6.4	3.9	7.5	3.4
Reithrodontomys montanus griseus, Lancaster County							
4313 NSM, ♂	19.1	10.1	.....	6.4	.....	7.5	3.2
34858 CNHM, ♀	19.0	10.3	3.3	6.4	.....	7.7	3.5
Peromyscus leucopus aridulus, vicinity Valentine, Cherry County							
Average 23 (16♂, 7♀)	27.3	14.5	4.2	10.3	5.4	9.8	4.0
Minimum	26.2	13.7	3.8	9.5	5.1	9.3	3.8
Maximum	28.3	15.2	4.4	10.9	5.7	10.3	4.3
Peromyscus leucopus noveboracensis, 4 mi. E Barada, Richardson County							
Average 25 (11♂, 14♀)	27.1	13.9	4.2	10.3	5.4	9.7	3.9
Minimum	25.4	13.0	3.9	9.3	4.8	9.1	3.5
Maximum	28.3	14.7	4.4	11.0	5.8	10.1	4.1
Peromyscus maniculatus bairdii, Richardson County							
Average 15 (8♂, 7♀)	24.4	13.1	3.8	9.4	5.2	8.9	3.7
Minimum	23.1	12.5	3.7	8.9	4.9	8.5	3.4
Maximum	24.8	13.7	4.0	9.6	5.5	9.3	3.8
Peromyscus maniculatus luteus, Cherry County							
Average 20 (11♂, 9♀)	24.5	13.3	4.0	9.4	5.2	9.0	3.8
Minimum	23.3	12.6	3.7	8.9	4.8	8.8	3.6
Maximum	25.5	13.7	4.2	10.1	4.6	9.3	4.3
Peromyscus maniculatus nebrascensis, Sioux County							
Average 25 (15♂, 10♀)	25.6	13.6	3.9	10.0	5.5	9.2	4.0
Minimum	24.3	13.0	3.7	9.3	5.1	8.6	3.6
Maximum	26.5	14.3	4.3	10.3	5.9	9.9	4.3
Onychomys leucogaster arcticeps, Cherry County							
73381 KU, ♂	27.9	15.6	4.4	9.7	4.9	10.2	4.7
73383 KU, ♀	28.4	15.5	4.7	10.5	5.5	10.3	4.7
78374 KU, ♂	27.3	15.6	4.7	9.6	5.2	10.3	4.5
5 mi. N, 2 mi. W Parks, Dundy County							
Average 5 (3♂, 2♀)	28.0	14.8	4.8	10.1	5.3	10.4	4.5
Minimum	27.5	14.4	4.6	9.8	4.9	10.0	4.2
Maximum	28.9	15.6	4.9	10.6	5.9	10.8	4.7
Onychomys leucogaster breviauritus, Franklin County							
74990 KU, ♂	29.1	14.9	4.7	10.5	5.9	10.4	4.8

than other Nebraskan specimens and approach *O. l. arcticeps* in this regard; they are, however, fairly typical of *breviauritus* in color.

As mentioned previously, the riparian association along the Missouri River undoubtedly serves as a barrier to eastward dispersal of *Onychomys leucogaster* at the latitude of Nebraska. Findley (1956*b*:33) referred grasshopper mice from Clay County, South Dakota (on the north side of the Missouri opposite Cedar and Dixon counties), to the subspecies *O. l. leucogaster.* Probably that subspecies is limited in the southern part of its range to the region north and east of the Missouri. The grasshopper mouse from Dickinson County, Iowa, that was referred by Dice (1924:66) to *O. l. breviauritus* is, on physiographic grounds, most likely referable to *O. l. leucogaster.*

Records of occurrence.—Specimens examined, 24, as follows: ADAMS COUNTY: no specific locality, 5 (HM). ANTELOPE COUNTY: Neligh, 8 (3 NSM, 5 USNM). CLAY COUNTY: Saronville, 2 (UF). FRANKLIN COUNTY: 2 mi. S Franklin, 1. KNOX COUNTY: 1-1½ mi. SE Niobrara, 4 (3 NGFPC); *2.2 mi. S Niobrara,* 1 (NGFPC). LANCASTER COUNTY: S of Lincoln, 1 (NSM). WAYNE COUNTY: 4 mi. SE Carroll, 1 (NSM). WEBSTER COUNTY: Bladen, 1 (HM).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). CLAY COUNTY: Trumbull (Swenk, MS).

Sigmodon hispidus

Cotton Rat

The cotton rat is known from but a single locality, which is in Richardson County (Jones, 1960*b*:132) in the southeastern corner of the state and is the northernmost record for the species in North America. There, on the night of November 15-16, 1958, R. R. Patterson and I trapped 12 specimens, one adult and 11 juveniles, in ditches along a little-used road in the valley of the South Fork of the Nemaha River, 3½ mi. S and 1 mi. W Dawson. Most of the cotton rats were trapped in the bottoms of the ditches in fairly thick stands of slough grass and switch grass; most were trapped in runs that were used by, and perhaps partially made by, at least seven other species of small mammals, especially *Microtus ochrogaster* and *Synaptomys cooperi.* Patterson and Sydney Anderson visited this same locality the following spring, found that cattle had grazed and trampled the ditches, and found no cotton rats there or elsewhere in the immediate vicinity.

Probably *Sigmodon hispidus* occurs at some other places along the southern border of Nebraska, especially in the southeastern part as far west as the Blue River, and in the valley of the Republican River. The species has been recorded from Brown, Marshall, Nor-

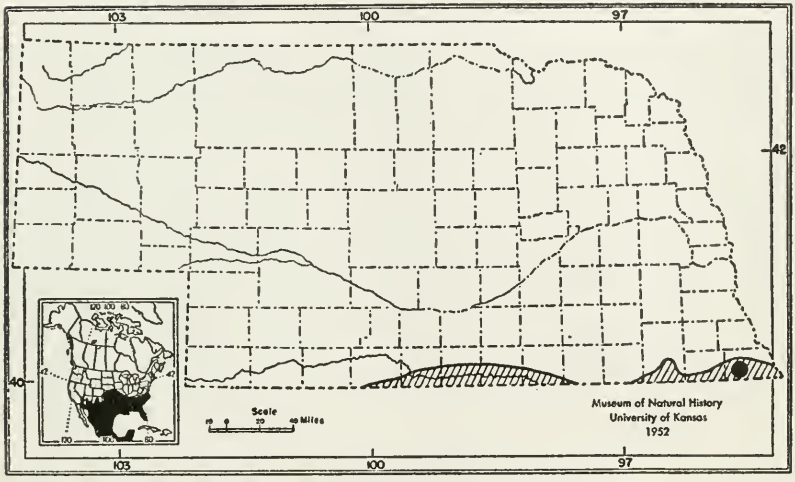

FIG. 44. Distribution of *Sigmodon hispidus texianus* in Nebraska. For explanation of symbols see Fig. 5.

ton, and Smith counties, Kansas (Cockrum, 1952:186; Anderson and Nelson, 1958:306), all of which adjoin Nebraska.

Cockrum (1948) summarized the northward spread in this century of the cotton rat in Kansas, which in the 14 years from 1933 to 1947 averaged slightly more than seven miles per year. After 1947 dispersal of the species northward and westward continued; the specimens collected in Nebraska in 1958 were taken in an area where cotton rats had been sought in almost every year since 1945.

Probably the general warming trend on the North American continent is mostly responsible for the northward movement of *Sigmodon hispidus*. Severe winters, which have prolonged periods of low temperature or a heavy ground-cover of snow or ice, are known to cause drastic reductions in numbers of the cotton rat in northeastern Kansas and are thought to be the principal limiting factor to continued northward dispersal. The winters of 1948-49, 1951-52, 1959-60, and 1961-62 were severe enough in the vicinity of Lawrence, Kansas, to reduce significantly the population of cotton rats there. Sufficient suitable habitat for *S. hispidus* is available in southern Nebraska but the species probably will be found in numbers only after two or more consecutive mild winters.

The cotton rat breeds from early spring to late autumn (in the warmer parts of its range) according to Asdell (1946:239). Cockrum (1952:186) reported an average of 6.0 (3-12) embryos per pregnant female in Kansas.

Sigmodon hispidus texianus (Audubon and Bachman)

Arvicola texiana Audubon and Bachman, The viviparous quadrupeds of North America, 3:229, 1853 (type locality, Brazos River, Texas).

Sigmodon hispidus texianus, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 3:287, June 30, 1891; Jones, Jour. Mamm., 41:132, February 20, 1960.

Distribution in Nebraska.—Known only from one locality in Richardson County; probably ocurs also in other areas in extreme southern Nebraska. See Fig. 44.

External measurements.—Measurements of a male from Richardson County are: 285; 113; 31.5; 16. This specimen weighed 157.5 grams. Cockrum (1952:186) recorded the average of three males and 12 females, respectively, from Kansas as: 239.6, 251.5; 102.3, 102.5; 30.5, 31.6; 17.0, 17.5; weight, 71.7 and 94.6 grams. For cranial measurements of the male from Richardson County see Table 15.

Records of occurrence.—Specimens examined, 12, as follows: RICHARDSON COUNTY: 3½ mi. S, 1 mi. W Dawson, 12.

Neotoma cinerea

Bushy-tailed Woodrat

The bushy-tailed woodrat inhabits the cliffs and rocky outcroppings of the western part of the Panhandle and occurs also in the rough breaks and rocky areas along the North Platte River east at least to the vicinity of Oshkosh. In some places the species is common, for example in the outcroppings of the Arikaree group (Miocene) on the Pine Ridge in Sioux County and on the Wildcat Ridge in Banner County; it occurs also in outcroppings and breaks of the Ogallala group (Pliocene) in the southern part of the Panhandle, and in the Badlands of the Brule formation (White River Oligocene) to the north of the Pine Ridge and elsewhere. While rocks seem to provide the preferred location for homesites, *N. cinerea* frequently inhabits abandoned buildings as well.

No specimens of this woodrat have been taken to date in Dawes County, but the species almost certainly occurs there on at least the higher areas of the Pine Ridge. The easternmost report of occurrence in Nebraska, from Oshkosh, is a manuscript record by Swenk, but specimens have been taken at a place 3 mi. NW Lisco, only 17 miles northwestward from Oshkosh, and seemingly suitable habitat for *N. cinerea* is present along the North Platte Valley at Oshkosh and on eastward into Keith County.

A female obtained on July 4, 1957, in Sioux County had four suckling young. Finley (1958:395-398) recorded 1-6 embryos per pregnancy for the species in Colorado; he noted that females may breed in their first year and that adults may breed twice annually.

Neotoma cinerea rupicola J. A. Allen

Neotoma rupicola J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:323, November 7, 1894 (type locality, Corral Draw, 3700 ft., Shannon Co., South Dakota); Cary, Proc. Nebraska Ornith. Union, 3:66, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:100, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:44, September, 1908 (part).

Neotoma cinerea rupicola, Goldman, N. Amer. Fauna, 31:107, October 19, 1910; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Quay, Jour. Mamm., 29:181, May 14, 1948; Hall and Kelson, The mammals of North America, p. 704, March 31, 1959.

N[eotoma]. cinera [sic], Aughey Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Neotoma orolestes, Swenk, Proc. Nebraska Acad. Sci., 8:101, September, 1908 (part); Swenk, Studies Zool. Lab. Univ. Nebraska, 89:45, September, 1908 (part).

N[eotoma]. c[inerea]. rupicola, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Distribution in Nebraska.—Western part of Panhandle, east certainly along breaks of North Platte River to Garden County. See Fig. 45.

External measurements.—Average and extreme measurements of six specimens (three males, three females) from the Panhandle are 353.8 (325-387); 149.7 (137-159); 39.7 (37-44); 33.0[4] (32-34). For cranial measurements see Table 15.

Two males and two females from the above-mentioned series weighed in grams, respectively, 284.9, 230.9, 235.0 and 174.7.

Records of occurrence.—Specimens examined, 34, as follows: BANNER COUNTY: 10 mi. W Harrisburg, 5 (NSM). MORRILL COUNTY: 3 mi. NW Lisco, 3. SCOTTS BLUFF COUNTY: Scottsbluff, 1 (HM); 11-12 mi. S. Scottsbluff, 4600-4800 ft., 2. SIOUX COUNTY: 11 mi. N Harrison, 1; *Warbonnet Canyon,* 2 (NSM); *8 mi. N Harrison,* 1 (UMMZ); Five Points, sec. 5, T. 32 N, R. 54 W, 1 (NSM); *Monroe Canyon, 5½ mi. N, 2½ mi. W Harrison,* 3 (NGFPC); Monroe Canyon, 3 (1 AMNH, 2 NSM); *1½ mi. N, 11 mi. W Crawford,* 5 (3 NSM); Glen, 5 (NSM); 4 mi. E Agate, 1; *no specific locality,* 1 (NSM).

Additional record: GARDEN COUNTY: Oshkosh (Swenk, MS).

Neotoma floridana

Eastern Woodrat

The eastern woodrat occurs in Nebraska only in the southwest and in an isolated area along the Niobrara River in the north-central part of the state. In the vicinity of Valentine, according to V. Bailey (1905:109), individuals "inhabit the cliffs and caves along the [wooded] canyon walls, and forage in the brush and timber along the sides and bottoms of the canyons." I have found them there also in abandoned or little-used buildings. In the southwest, the species inhabits the few areas of rock outcroppings, such as those along the Frenchman River, 5 mi. S Imperial (where nests have been observed), but most often builds its characteristic stick houses in wooded valleys, in thickets in rough canyons and breaks, or in abandoned buildings.

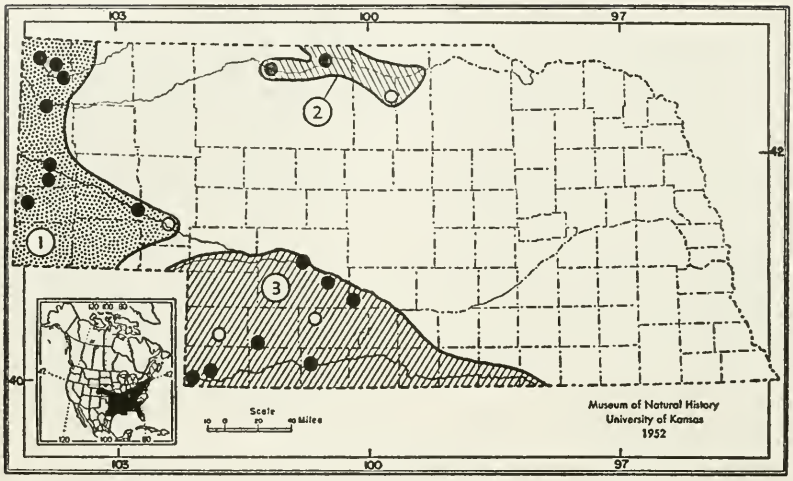

FIG. 45. Distribution of two species of woodrats in Nebraska. 1. *Neotoma cinerea rupicola.* 2. *Neotoma floridana baileyi.* 3. *Neotoma floridana campestris.* For explanation of symbols see Fig. 5. Inset map shows distribution of *N. floridana* in North America.

Insofar as now known, the geographic range of *Neotoma floridana* does not overlap that of the bushy-tailed woodrat, *Neotoma cinerea,* in Nebraska or elsewhere. Presently, *N. f. campestris* is known from the Platte Valley at North Platte and *N. c. rupicola* is known from 85 miles westward along the Platte at Oshkosh. Seemingly suitable habitat for *N. floridana* prevails, however, in the Platte Valley westward into Keith County and the species possibly occurs there along both the north and south forks of the river; on the other hand, rock outcroppings along the North Platte as far southeast as Ogallala may provide suitable homesites for *N. cinerea.* The places in Keith County where overlap might be found have, to my knowledge, not been investigated intensively. *N. floridana* is easily distinguished from *N. cinerea* externally by its darker upper parts, smaller ears, and non-bushy tail, and cranially by its shorter incisive foramina, broader and more arched interorbital region, smaller bullae, forked anterior palatal spine, much broader mesopterygoid fossa, and lack of a foramen in the nasal septum.

A female obtained on July 15 carried 4 embryos. Each of two females (one taken on June 16 and the other on June 26) were accompanied by 4 young. Rainey (1956:609-610) reported females with 1-5 embryos or young in eastern Kansas.

Neotoma floridana baileyi Merriam

Neotoma baileyi Merriam, Proc. Biol. Soc. Washington, 9:123, July 2, 1894 (type locality, Valentine, Cherry Co., Nebraska).

Neotoma floridana baileyi, V. Bailey, N. Amer. Fauna, 25:109, October 24, 1905; Swenk, Proc. Nebraska Acad. Sci., 8:100, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:44, September, 1908; Goldman, N. Amer. Fauna, 31:24, October 19, 1910 (part); Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Poole and Schantz, Bull. U. S. Nat. Mus., 178:286, April 9, 1942; Hall and Kelson, The mammals of North America, p. 683, March 31, 1959.

Neotoma Floridana, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

N[eotoma]. baileyi, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:323, November 7, 1894.

N[eotoma]. f[loridana]. baileyi, Blair, Occas. Papers Mus. Zool., Univ. Michigan, 403:7, June 16, 1939; Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Known presently only from vicinity of Niobrara River in Brown and Cherry counties. See Fig. 45.

External measurements.—Average and extreme measurements of 13 specimens (six males, seven females) from northern Cherry County are: 376.8 (350-398); 166.1 (136-180); 39.4 (38-41); 25.5[2] (25-26). For cranial measurements see Table 15.

One of the females, pregnant with four large embryos (35 mm. crown-rump) weighed 376.2 grams.

Remarks.—For comparison with *Neotoma floridana campestris* of southwestern Nebraska, see account of that subspecies.

N. f. baileyi represents an isolated population of woodrats in the Niobrara Valley of northern Nebraska. Post-Wisconsin climatic shifts probably are responsible for this relict population, as explained on pp. 26-27. Specimens are presently available only from along the Niobrara itself in northern Cherry County but a manuscript report (Swenk, MS) from Long Pine indicates that the subspecies occurs eastward along the Niobrara in northern Brown and southern Keya Paha counties. Probably it occurs also along at least some of the few tributaries of the Niobrara, like the Snake River and Gordon Creek to the south in central Cherry County, and along Minichaduza Creek to the north, whence it may reach South Dakota. The subspecies previously was reported from the latter state by Goldman (1910:25), based on a single specimen from Spring Creek, 18 mi. SE Rapid City, but my examination of this specimen in the U. S. National Museum indicates that it is without question *Neotoma cinerea rupicola.*

In color and in some cranial features *N. f. baileyi* resembles *Neotoma floridana osagensis* Blair (type locality, Okesa, Osage County,

Oklahoma) of eastern Kansas more than it does *N. f. campestris*. *N. f. osagensis* possibly occurs in extreme southeastern Nebraska, although I have sought it unsuccessfully in all southeastern counties bordering Kansas. Rainey (1956:634-637) reported the subspecies from localities in Marshall County, Kansas, only 15 miles south of the Nebraska border; he, too, failed to find *osagensis* in Nebraska, although he searched for it (p. 635) in Osage orange hedgerows in Pawnee and Richardson counties, and in rock outcroppings and abandoned buildings along the Blue River in the vicinity of Barnston, Gage County.

Rainey (pp. 636-637) concluded that both physiographical and biological factors limited dispersal of the eastern woodrat to southeastern Nebraska. He pointed out that one of the major factors was "disruption of habitat," especially the absence of outcropping rock coupled with intervening areas of open country, and that "scarcity of overhead cover limits the spread of populations of woodrats when discontinous habitat is encountered." Climatic extremes also were mentioned as a possible limiting factor.

Records of occurrence.—Specimens examined, 33, as follows: CHERRY COUNTY: Valentine, 6 (USNM); *4 mi. E Valentine,* 6; *Clark's Canyon, near Valentine,* 11 (USNM); *3 mi. SSE Valentine,* 1; 10 mi. S Cody, 9 (4 NSM, 5 USNM).

Additional record: BROWN COUNTY: Long Pine (Swenk, MS).

Neotoma floridana campestris J. A. Allen

Neotoma campestris J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:322, November 7, 1894 (type locality, Pendennis, Lane Co., Kansas).

Neotoma floridana campestris, Kellogg, Kansas Univ. Mus. Nat. Hist., Zool. Ser., 1(1):5, January 30, 1914; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:485, April 21, 1954; Hall and Kelson, The mammals of North America, p. 683, March 31, 1959.

Neotoma floridana baileyi, Goldman, N. Amer. Fauna, 31:24, October 19, 1910 (part).

N[eotoma]. f[loridana]. campestris, Jones, Trans. Kansas Acad. Sci., 60:277, October 22, 1957.

Distribution in Nebraska.—Southwestern part of state south of Platte River. See Fig. 45.

External measurements.—Measurements of a male and two females from 5 mi. N and 2 mi. W Parks are, respectively: 395, 363, 378; 162, 160, 151; 44, 40, 39; 30, 25, 26. Four young adults from the same locality (a male and three females, respectively) measured: 360, 348, 324, 333; 155, 148, 147, 148; 42, 40, 43, 41; 31, 26, 30, 29. For cranial measurements see Table 15. Respective weights in grams of three of the last-mentioned specimens, the male and two females, were 234.0, 228.0, and 180.0.

Remarks.—From *Neotoma floridana baileyi* of northern Nebraska, *N. f. campestris* differs in: upper parts and dorsal aspect of tail distinctly paler; skull larger in most dimensions (see Table 15), especially in lengths of rostrum, nasals, incisive foramina, and tooth-

rows, and in depth of skull; palate relatively and actually shorter; zygomatic notches deeper. The paleness, shortness of palate, and greater length of incisive foramina in comparison with *baileyi* were noted in the original description of *campestris* (J. A. Allen, 1894:323).

The subspecies *N. f. campestris* was first reported from Nebraska (Jones, 1954:485) based on specimens from 5 mi. N and 2 mi. W Parks, although previously Goldman (1910:25) listed a specimen from Haigler as *N. f. baileyi*. He regarded *campestris* as a synonym of *baileyi*.

Records of occurrence.—Specimens examined, 20, as follows: DAWSON COUNTY: Quinn's Canyon, 10 mi. S Gothenburg, 1 (NSM). DUNDY COUNTY: Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, 9 (1 NGFPC); Haigler, 1 (USNM). HAYS COUNTY: ½ mi. S Hamlet, 1 (NSM). LINCOLN COUNTY: North Platte, 1 (NSM); Conroy Canyon, sec. 10, T. 11 N, R. 27 W (5 mi. S, 2½ mi. W Brady), 6 (NSM). RED WILLOW COUNTY: McCook, 1 (NSM).

Additional records: CHASE COUNTY: 5 mi. S Imperial (see account of species above). FRONTIER COUNTY: vicinity Curtis (Swenk, MS).

TABLE 15.—CRANIAL MEASUREMENTS OF SIGMODON AND NEOTOMA.

Number of specimens averaged or catalogue number, and sex	Greatest length of skull	Zygomatic breadth	Interorbital constriction	Length of nasals	Depth of skull	Length of maxillary tooth-row	Length of incisive foramen
Sigmodon hispidus texianus, Richardson County							
79157 KU, ♂	36.0	19.9	5.4	13.3	13.7	6.8	8.0
Neotoma cinerea rupicola, 3 mi. NW Lisco, in Morrill County							
80974 KU, ♀	46.9	.....	6.3	19.3	16.3	9.7	11.1
80976 KU, ♂	48.2	26.2	6.1	19.0	16.5	9.5	11.1
Sioux County							
4248 NSM, ♀	47.0	25.1	6.0	17.8	16.4	10.4	10.4
4252 NSM, ♂	49.9	27.4	5.7	19.5	17.6	9.8	11.9
335 NGFPC, ♂	50.1	25.5	5.8	19.5	17.1	9.7	11.3
Neotoma floridana baileyi, northern Cherry County							
Average 10 (4♂, 6♀)	49.2	26.2	6.9	18.7	16.9	9.3	9.5
Minimum	48.2	25.6	6.4	18.2	16.5	8.9	9.1
Maximum	50.6	26.9	7.3	19.7	17.4	9.6	9.8
Neotoma floridana campestris, Lincoln County							
68 NSM, ♂	53.6	28.1	6.9	22.5	19.2	9.7	10.6
76 NSM, ♀	49.2	27.0	6.6	19.4	17.0	10.0	10.2
5 mi. N, 2 mi. W Parks, Dundy County							
50107 KU, ♂	53.9	28.7	6.8	20.7	18.2	10.0	10.6
50108 KU, ♀	50.6	26.8	6.6	20.1	17.9	10.4	10.5
72600 KU, ♀	48.8	.....	6.7	19.1	17.7	9.7	9.8

Synaptomys cooperi

Southern Bog Lemming

The southern bog lemming was first reported from Nebraska by Fichter and Hansen (1947), who trapped 22 specimens in dense grassy areas at the northern outskirts of Lincoln between September, 1946, and May, 1947. Subsequent collecting has shown that the species is generally distributed in eastern Nebraska but it is restricted locally to favorable habitats and thus uncommon. Most of the specimens recently obtained in the eastern part of the state have been trapped along fencerows at places where low groundcover was dense beneath an overstory of tall grasses, sunflowers, sumac, wild plum, or the like.

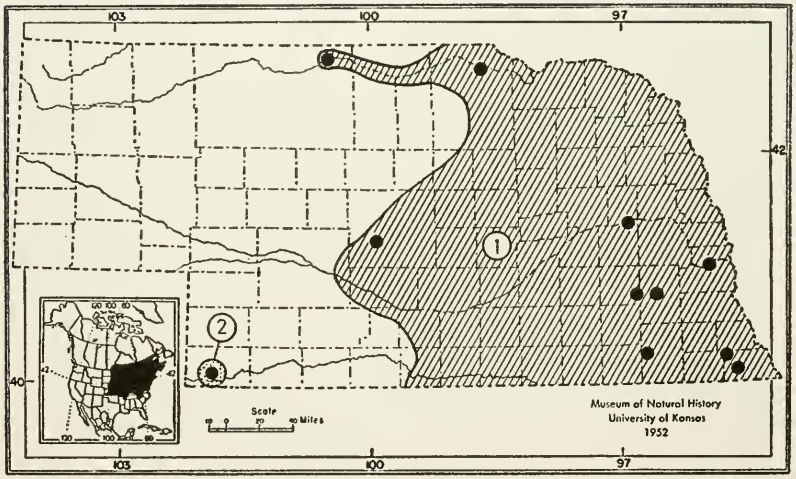

FIG. 46. Distribution of *Synaptomys cooperi* in Nebraska. 1. *S. c. gossii.* 2. *S. c. relictus.* For explanation of symbols see Fig. 5.

Synaptomys cooperi gossii, the subspecies in eastern Nebraska, ranges westward along the Niobrara and Loup rivers, and probably also along the Platte, to approximately the 100th meridian. Agricultural practices and floods have, over the years, been responsible for destruction of much of the habitat suitable to the species in at least the western half of its range in the state. In Dundy County in extreme southwestern Nebraska, a relict population, *Synaptomys cooperi relictus,* inhabits the grassy riparian community around some rearing ponds and along Rock Creek at Rock Creek Fish

Hatchery. The total population of *relictus* probably is small because the suitable habitat is apparently restricted to an area approximately 100 yards wide and one mile long at the hatchery.

Six females, all obtained in May, carried an average of 4.7 (4-6) embryos. A female taken on October 5, 1955, contained a single embryo. A. B. Howell (1927:2) suggested that females produce several litters annually in the warmer months.

Synaptomys cooperi gossii (Coues)

Arvicola (Synaptomys) gossii Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:235, August, 1877—name appeared in synonymy under *Synaptomys cooperi* but said to apply to Kansan specimens, description and measurements of which are on p. 236 (type locality, Neosho Falls, Woodson Co., Kansas).

Synaptomys cooperi gossi, Rhoads, *in* Rhoads and Young, Proc. Acad. Nat. Sci. Philadelphia, 49:307, June, 1897.

Synaptomys cooperi gossii, Fichter and Hansen, Bull. Univ. Nebraska State Mus., 3(2):1, September, 1947; Hall and Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 5:475, January 15, 1953; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:486, April 21, 1954 (part); Wetzel, Jour. Mamm., 36:16, February 28, 1955 (part); Miller and Kellogg, Bull. U. S. Nat. Mus., 205:562, March 3, 1955; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:387 (see p. 388), May 12, 1958; Hall and Kelson, The mammals of North America, p. 762, March 31, 1959 (part); Jones, Jour. Mamm., 41:132, February 20, 1960.

S[ynaptomys]. c[ooperi]. gossii, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957 (part).

Distribution in Nebraska.—Eastern half of state, west certainly to Cherry and Custer counties. See Fig. 46.

External measurements.—Average and extreme measurements of eight specimens (five males, three females) from eastern Nebraska are: 142.0 (136-152); 22.2 (18-25); 21.1 (20-26); 11.7 (10-13). One male from the above series weighed 41.3 grams. For cranial measurements see Table 16.

Remarks.—From *Synaptomys cooperi relictus*, known only from Dundy County, Nebraskan specimens of *S. c. gossii* differ in averaging slightly paler in comparable pelages, having (in most specimens) a distinct buffy tinge on the venter, and in having smaller teeth and shorter molar tooth-rows. The contention in the original description of *relictus* (Jones, 1958*a*:338) that it averaged larger in most cranial dimensions than *gossii* is not borne out by recently collected specimens of the latter from eastern Nebraska, some of which are larger externally and in some cranial dimensions than the average in *S. c. paludis* of Meade County, Kansas (see Wetzel, 1955:10), the largest subspecies of *S. cooperi*.

Records of occurrence.—Specimens examined, 34, as follows: BUTLER COUNTY: 4 mi N, ½ mi. E Octavia, 1. CASS COUNTY: 1 mi. NE Louisville, 2. CHERRY COUNTY: Valentine, 1 (UNDZ). CUSTER COUNTY: 1 mi. NW Callaway, 1 (NSM). GAGE COUNTY: ¼ mi. W Homestead Nat'l Mon., 7.

HOLT COUNTY: 6 mi. N Midway, 2. LANCASTER COUNTY: Lincoln, 10 (3 NGFPC, 4 NSM, 1 UC, 2 USNM); *College View (Lincoln),* 1 (UC); *Stevens Creek, E of Lincoln,* 1 (NSM). RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 1; 3½ mi. S, 1 mi. W Dawson, 6. SEWARD COUNTY: 1 mi. N Pleasant Dale, 1.

Synaptomys cooperi relictus Jones

Synaptomys cooperi relictus Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:387, May 12, 1958 (type locality, Rock Creek Fish Hatchery, 5 mi. N, 2 mi. W Parks, Dundy Co., Nebraska); Hall and Kelson, The mammals of North America, p. 1081, March 31, 1959 (part, see also p. 762).

Synaptomys cooperi gossii, Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:486, April 21, 1954 (part); Wetzel, Jour. Mamm., 36:16, February 28, 1955 (part); Hall and Kelson, The mammals of North America, p. 762, March 31, 1959 (part).

S[ynaptomys]. c[ooperi]. gossii, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957 (part).

Distribution in Nebraska.—Known only from the type locality. See Fig. 46.

External measurements.—Measurements of two females, the holotype and another specimen from the type locality are, respectively: 141, 145; 24, 21; 20, 20; 11, 12. The holotype weighed 46.3 grams. For cranial measurements of these same two specimens see Table 16.

Remarks.—For comparison with *Synaptomys cooperi gossii* of eastern Nebraska, see account of that subspecies.

S. c. relictus, like *S. c. paludis* of Meade County, Kansas, represents a relict population of the more southwesterly distribution of the subgenus *Synaptomys* in Wisconsin and post-Wisconsin times. The specimens on which the name *relictus* is based are from the Republican River drainage system and provide the westernmost locality of record for the subgenus in North America. The nearest reported occurrence of *S. c. gossii* is from 1 mi. NW Callaway, along the South Loup River, approximately 115 miles to the northwest.

Records of occurrence.—Specimens examined, 4, all from the type locality.

Microtus ochrogaster

Prairie Vole

This species is the most abundant of the state's microtine rodents and in some areas rivals *Peromyscus maniculatus* and *Reithrodontomys megalotis* as the commonest mammal. It is widely distributed in the eastern part of the state, occurring wherever a suitable cover of vegetation is available. In the western part of the state the prairie vole is more or less restricted to the vicinity of permanent or semi-permanent water, although its tolerance to relatively xeric conditions stands in contrast to that of the meadow vole, *M. pennsylvanicus.*

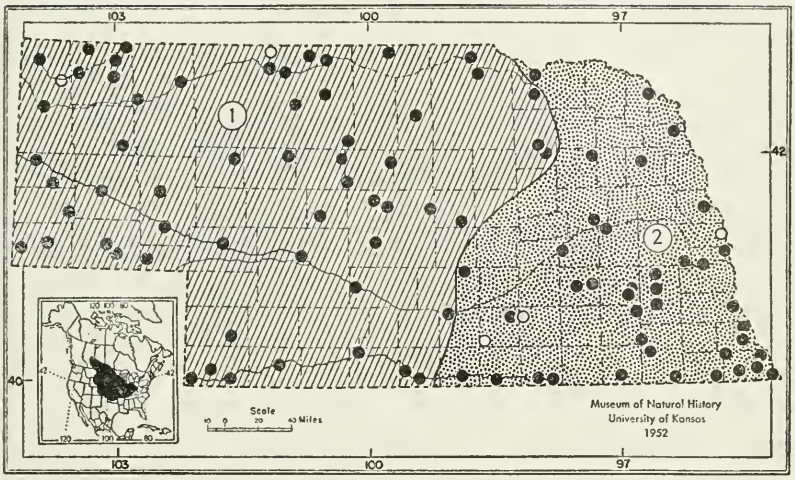

FIG. 47. Distribution of *Microtus ochrogaster* in Nebraska. 1. *M. o. haydenii.* 2. *M. o. ochrogaster.* For explanation of symbols see Fig. 5.

Color abberations evidently occur more frequently in *M. ochrogaster* than in most other Nebraskan cricetids. I have examined one albino, several individuals that were pale tan, and a number having white blotches or stripes at one place or another on the body. Cockrum (1953:86-88) discussed and figured two Nebraskan individuals having such white areas.

Females are polyestrous but ordinarily do not breed in the coldest months in Nebraska. Autopsy of 110 pregnant animals, taken in the months of April through November, revealed an average of 3.6 (1-6) embryos; the mode was 3.

Microtus ochrogaster haydenii (Baird)

Arvicola (*Pedomys*) *haydenii* Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):543, July 14, 1858 (type locality, Fort Pierre, Stanley Co., South Dakota); J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:328, November 7, 1894.

Microtus ochrogaster haydeni, Osgood, Proc. Biol. Soc. Washington, 20:48, April 18, 1907; Swenk, Proc. Nebraska Acad. Sci., 8:103, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:47, September, 1908; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

Arvicola (*Pedomys*) *austerus,* Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:210, August, 1877.

?*A[rvicola]. curtatus,* Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Microtus (Pedomys) austerus, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:248, November, 1896.

Microtus austerus haydeni, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

Microtus ochrogaster, Swenk, Proc. Nebraska Acad. Sci., 8:103, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:47, September, 1908 (part); Findley, Ecology, 35:418, July, 1954.

Microtus haydeni, Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:26, October, 1936.

Microtus haydenii, Imler, Jour. Wilidlife Mgt., 9:272, October, 1945.

Microtus ochrogaster haydenii, Bole and Moulthrop., Sci. Publ., Cleveland Mus. Nat. Hist., 5:159, September 11, 1942; Hall and Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 5:446, January 15, 1953; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:388, May 12, 1958; Hall and Kelson, The mammals of North America, p. 748, March 31, 1959.

M[icrotus]. o[chrogaster]. haydenii, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Distribution in Nebraska.—Western part of state, east certainly to Antelope, Harlan, Kearney, and Knox counties. See Fig. 47.

External measurements.—Average and extreme measurements of 26 specimens (six males, 20 females) from the vicinity of Valentine are: 165.6 (153-186); 37.0 (33-45); 21.1 (20-23); 12.3 (11-15). Corresponding measurements of 24 specimens (nine males, 15 females) from Scotts Bluff County are: 157.7 (147-168); 38.6 (33-43); 20.5 (19-22); 12.5 (11-14). For cranial measurements see Table 16.

Weight in grams of 11 individuals (four males, seven females) from the first-listed series averaged 60.1 (49.6-70.5) and that of 16 specimens (four males, 12 females) from Scotts Bluff County averaged 48.0 (42.6-57.7).

Remarks.—For comparison with *Microtus ochrogaster ochrogaster,* geographically adjacent to the east in Nebraska, see account of that subspecies.

As might be expected, the zone of intergradation between the subspecies *ochrogaster* and *haydenii* is relatively broad, and assignment of specimens from this area oftentimes is difficult. Samples from all along the eastern part of the range herein assigned to *haydenii* are darker dorsally than typical specimens and thus are intergrades with *ochrogaster.* Similarly, individuals from the western part of the range ascribed to *ochrogaster* are somewhat paler than examples of that subspecies from southeastern Nebraska. The difficulty in assigning intergrades is typified by specimens examined from Knox County. Seven individuals from along the Missouri and Niobrara rivers in the vicinity of Niobrara are only slightly darker on the average than six mice from Verdigre to the south, but the former fall nearer *ochrogaster* in color and the latter nearer *haydenii.* In addition to those from Knox County, specimens assigned to *haydenii* from the following counties are reckoned as intergrades: Antelope, Boyd, Buffalo, Custer (those from Comstock

only), Harlan, Holt, Rock, and Valley. The specimens from Perch originally were assigned (J. A. Allen, 1896:248) to *austerus* [= *ochrogaster*].

Examples of *haydenii* studied from Cherry County and adjacent areas resemble South Dakotan topotypes of the subspecies more closely than do other specimens examined from Nebraska. Individuals from the Panhandle, especially those from the western part thereof, average paler than typical specimens and are slightly smaller cranially, especially in lambdoidal breadth. In some particulars of size they resemble *M. o. ochrogaster* from eastern Nebraska more than *haydenii*. The possibility that these pale mice represent an unnamed subspecies was examined and, although a case could be made for subspecific recognition, they seem, on the basis of materials at hand, best regarded as pale variants of *haydenii*.

Records of occurrence.—Specimens examined, 547, as follows: ANTELOPE COUNTY: Neligh, 20 (7 NSM, 13 USNM); *1 mi. SW Neligh*, 7; Oakdale, 1 (NSM). BANNER COUNTY: 8 mi. SW Redington, 1 (NSM). BLAINE COUNTY: Dismal River, 2 mi. S, 8 mi. W Dunning, 1. BOX BUTTE COUNTY: Alliance, 2 (USNM). BOYD COUNTY: 5 mi. WNW Spencer, 3. CHERRY COUNTY: W of Crookston, 6 (NSM); *Ft. Niobrara Nat'l Wildlife Refuge*, 3 (NSM); Valentine, 16 (3 UMMZ, 1 UNDZ, 12 USNM); *4 mi. E Valentine*, 28; *3 mi. SSE Valentine*, 8; *3 mi. S Valentine*, 9; Niobrara River, 10 mi. S Cody, 3 (1 NSM, 2 USNM); 8 mi. S Nenzel, 5; *11 mi. S, 2 mi. W Nenzel*, 1; *18 mi. NW Kennedy*, 3 (1 NSM, 1 USNM). *18 mi. S Valentine*, 1 (UNDZ); Ballard Marsh, 20 mi. S Valentine, 2; *Watt's Lake, Valentine Nat'l Wildlife Refuge*, 1; *Hackberry Lake, Valentine Nat'l Wildlife Refuge*, 22 (1 UMMZ); *1 mi. W Headquarters, Valentine Nat'l Wildlife Refuge*, 1 (UC); *Rice Lake, Valentine Nat'l Wildlife Refuge*, 1 (UC); *Pelican Lake, Valentine Nat'l Wildlife Refuge*, 3 (NGFPC); 4 mi. W to 4 mi. E Kennedy, 26 (4 UMMZ, 12 USNM); 30 mi. S Woodlake, 1 (CNHM). CHASE COUNTY: 2 mi. SE Enders, 1. CHEYENNE COUNTY: 15 mi. S Dalton, 4300 ft., 1; *3 mi. N Sidney, 4250 ft.*, 2; *Sidney*, 2 (USNM); 4 mi. E Sidney, 16. CUSTER COUNTY: 1 mi. NW Gavin, 1 (UMMZ); ½ mi. NE Victoria Springs, 3 (UMMZ); *2 mi. E Lillian*, 2 (UMMZ); Comstock, 3 (1 AMNH, 2 NSM); Callaway, 4 (USNM). DAWES COUNTY: Wayside, 1; 11 mi. NE Chadron, 1 (WFR); Chadron, 4 (2 CSTC, 2 NSM); *3 mi. E Chadron*, 2; Chadron State Park, 1 (NGFPC); *Ft. Robinson*, 1; Crawford, 2 (UMMZ). DAWSON COUNTY: ½ mi. S Gothenburg, 1; *3 mi. ESE Gothenburg*, 6; *5 mi. S Gothenburg*, 6. DEUEL COUNTY: 1 mi. N, 2 mi. W Chappell, 6. DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 43; 2 mi. N, 2 mi. W Haigler, 7; 2 mi. SW Benkleman, 6; *Haigler*, 1 (USNM). FURNAS COUNTY: 5 mi. W Holbrook, 3 (UI). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge, 1 (USNM); ½ mi. S Oshkosh, 13; *no specific locality*, 3. GRANT COUNTY: 12 mi. E Hyannis, 8 (MVZ). HARLAN COUNTY: 5 mi. W Orleans, 1 (NSM); 1 mi. S Alma, 1. HITCHCOCK COUNTY: Republican River, Trenton, 2. HOLT COUNTY: 6 mi. N Midway, 8. HOOKER COUNTY: Kelso, 2 (UMMZ). KEARNEY COUNTY: 1¾ mi. S Kearney, 1. KEITH COUNTY: 4 mi. WNW Keystone, 14. KEYA PAHA COUNTY: 12 mi. N Springview, 10; *12 mi. NNW Springview*, 2; *10 mi. N Springview*, 1 KIMBALL COUNTY: 3 mi. E Kimball, 2; Smeed, 10. KNOX COUNTY: Verdigre, 6 (USNM). LINCOLN COUNTY: 2 mi. N North Platte, 11. LOGAN COUNTY: 1 mi. NE Stapleton, 11. MORRILL COUNTY: 1 mi. N Bridgeport, 1. ROCK COUNTY: Perch, 7 (AMNH). SCOTTS

BLUFF COUNTY: Mitchell, 3 (NSM); *1 mi. S Mitchell,* 12; *5 mi. S Gering,* 4; *7 mi. S Gering,* 2; *10 mi. S Scottsbluff, 4300 ft.,* 1; *11 mi. S Scottsbluff, 4600 ft.,* 2; 12 mi. SSW Scottsbluff, 4700 ft., 48. SHERIDAN COUNTY: 11 mi. S Gordon, 1; Mirage Twp., 1 (UMMZ). SIOUX COUNTY: *Jim Creek,* 2 (NSM); *Warbonnet Canyon,* 10 (NSM); 8 mi. N Harrison, 4 (UMMZ); *West Monroe Canyon,* 4 (NSM); *Monroe Canyon,* 3 (2 NGFPC, 1 NSM); *4 mi. N, 1½ mi. W Harrison,* 1 (NGFPC); Agate, 4600 ft., 4 (1 UMMZ); *no specific locality,* 1 (NSM). THOMAS COUNTY: 5 mi. N Halsey, 2 (UMMZ); *Halsey to 4 mi. W thereof,* 11 (1 AMNH, 1 UC, 1 USNM); *Nebraska Nat'l Forest,* 5 (NGFPC). VALLEY COUNTY: 10 mi. S Ord, 8 (NGFPC). County unknown: *Platte River, 320 mi. from Ft. Riley,* 1 (USNM); *Crossing of the Platte,* 1 (USNM).

Additional records (Swenk, 1908:103): CHERRY COUNTY: Cody. SIOUX COUNTY: Glen.

Microtus ochrogaster ochrogaster (Wagner)

Hypudaeus ochrogaster Wagner, *in* Schreber, Die Säugthiere . . ., Supplement, 3:592, 1842 (type locality, America; probably New Harmony, Posey Co., Indiana, according to Bole and Moulthrop, Sci. Publ., Cleveland Mus. Nat. Hist., 5:157, September 11, 1942).

Microtus (Pedomys) ochrogaster, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 10:459, November 10, 1898.

A[rvicola]. austerus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Microtus ochrogaster, Swenk, Proc. Nebraska Acad. Sci., 8:103, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:47, September, 1908 (part); Whelan, Trans. Kansas Acad. Sci., 39:366, 1937.

Microtus ochrogaster ochrogaster, Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Bole and Moulthrop, Sci. Publ., Cleveland Mus. Nat. Hist., 5:158, September 11, 1942; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949; Hall and Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 5:447, January 15, 1953; Cockrum, Trans. Kansas Acad. Sci., 56:87, March 21, 1953; Hall and Kelson, The mammals of North America, p. 749, March 31, 1959; Jones, Jour. Mamm., 41:132, February 20, 1960.

M[icrotus]. o[chrogaster]. ochrogaster, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Distribution in Nebraska.—Eastern third of state, west certainly to Adams, Franklin, and Knox counties. See Fig. 47.

External measurements.—Average and extreme measurements of 17 specimens (11 males, six females) from Richardson County are: 157.8 (145-166); 36.0 (29-43); 20.0 (18-21); 13.8 (11-16). Average weight in grams for 11 individuals (seven males, four females) from the same series was 42.3 (36.0-49.9). For cranial measurements see Table 16.

Remarks.—From *Microtus ochrogaster haydenii,* geographically adjacent to the west in Nebraska, *M. o. ochrogaster* differs in being darker throughout, but especially dorsally, and in averaging slightly smaller in most external and cranial dimensions.

Specimens assigned to *ochrogaster* from Buffalo, Franklin, Knox, and Webster counties are intergrades with *haydenii* as discussed in the account of that subspecies.

Records of occurrence.—Specimens examined, 298, as follows: ADAMS COUNTY: Hastings, 2 (HM); *no specific locality,* 4 (HM). BUFFALO COUNTY: 1 mi. E Ravenna, 2 (UMMZ). BUTLER COUNTY: 2 mi. N, 2 mi. W Bellwood,

1 (NSM). CUMING COUNTY: Beemer, 1 (USNM); *1 mi. S Beemer*, 2. DIXON COUNTY: 3 mi. NE Ponca, 3. FRANKLIN COUNTY: 1½ mi. S Franklin, 1; *2 mi. S Franklin*, 4. GAGE COUNTY: 1 mi. SE De Witt, 1; ¼ mi. W Homestead Nat'l Mon., 1; 1½ mi. S, 2 mi. E Barnston, 12. JEFFERSON COUNTY: 7 mi. S, 2 mi. W Fairbury, 1; *3 mi. S, 1 mi. W Endicott*, 1. KNOX COUNTY: 3 mi. W Niobrara, 1; *Niobrara State Park*, 2 (NGFPC); *8 mi. SW Niobrara*, 4 (NGFPC). LANCASTER COUNTY: 12 mi. N Lincoln, 1 (UC); *"nine-mile prairie," NW of Lincoln*, 1 (NGFPC); *8 mi. NW Lincoln*, 2; within 5 mi. Lincoln, 59 (2 MVZ, 4 NGFPC, 17 NSM, 2 RV, 21 UC, 9 UNDZ, 2 USNM); 8 mi. S Lincoln, 1 (UC); *no specific locality*, 1 (NGFPC). MADISON COUNTY: Norfolk, 1 (USNM). NEMAHA COUNTY: 2 mi. SW Peru, 12; *3 mi. S, 1½ mi. E Peru*, 3; London, 12 (USNM). NUCKOLLS COUNTY: 2 mi. WSW Superior, 1; 1 mi. SSW Hardy, 15. OTOE COUNTY: 1 mi. SE Nebraska City, 6; *3 mi. S, 2 mi. E Nebraska City*, 3. PAWNEE COUNTY: 1 mi. S DuBois, 5. PLATTE COUNTY: 2 mi. N Columbus, 2 (UNDZ); *Columbus*, 7 (NSM). POLK COUNTY: 15 mi. W Osceola, 2. RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 3 (2 NSM); 4 mi. E Barada, 1; 2 mi. N Falls City, 2; 3½ mi. W Dawson, 18; *4-6 mi. W Falls City*, 11; 2 mi. S, 4 mi. E Rulo, 1; *3 mi. S Rulo*, 2. SALINE COUNTY: 2 mi. NE Crete, 5; *½ mi. W De Witt*, 1. SARPY COUNTY: *Fontanelle Forest*, 1 (UNDZ); Ft. Crook, 4 (AMNH); *2 mi. ESE La Platte*, 2; 1 mi. W Meadow, 7. SAUNDERS COUNTY: 2 mi. NW Ashland, 2. SEWARD COUNTY: Milford, 1 (UNDZ); 1 mi. N Pleasant Dale, 2. STANTON COUNTY: *4½ mi. SSE Norfolk (on Madison County line)*, 1. THURSTON COUNTY: 1 mi. S Winnebago, 15. WASHINGTON COUNTY: Blair, 6 (5 UMMZ, 1 USNM); *1 mi. E Blair*, 3; *3 mi. SE Blair*, 4; *6 mi. SE Blair*, 19. WEBSTER COUNTY: 3 mi. S Red Cloud, 6 (1 NSM). YORK COUNTY: Waco, 2 (UMMZ); York, 2 (1 NGFPC, 1 UNDZ).

Additional records (Swenk, MS): ADAMS COUNTY: Logan Twp. CLAY COUNTY: Inland. DOUGLAS COUNTY: Omaha.

Microtus pennsylvanicus

Meadow Vole

In the late Pleistocene the meadow vole occurred at least as far south on the Great Plains as southwestern Kansas. Warmer climates in post-Wisconsin time, probably especially the warm, dry (Xerothermic) period of the Hypsithermal Interval, eliminated meadow voles from areas to the south of the Platte River drainage with the exception of a relict population (*M. p. finitus*) along the western part of the Republican River in Nebraska and adjacent Colorado and in several areas just south of the Platte drainage in eastern Nebraska (Adams, Butler, and Seward counties) where *M. p. pennsylvanicus* occurs. Throughout its range in Nebraska the species is closely associated with permanent water and even in the northern part of the state has been taken only at scattered localities where local conditions favor its existence. Nebraska as a whole is a marginal part of the range of *M. pennsylvanicus*.

The meadow vole occurs sympatrically in Nebraska with the prairie vole, *M. ochrogaster*, and the two species occasionally are trapped in the same runs. More often, however, only one of the two kinds is taken at a given locality, or where they occur together *pennsylvanicus* inhabits the lower, wetter areas and *ochrogaster*

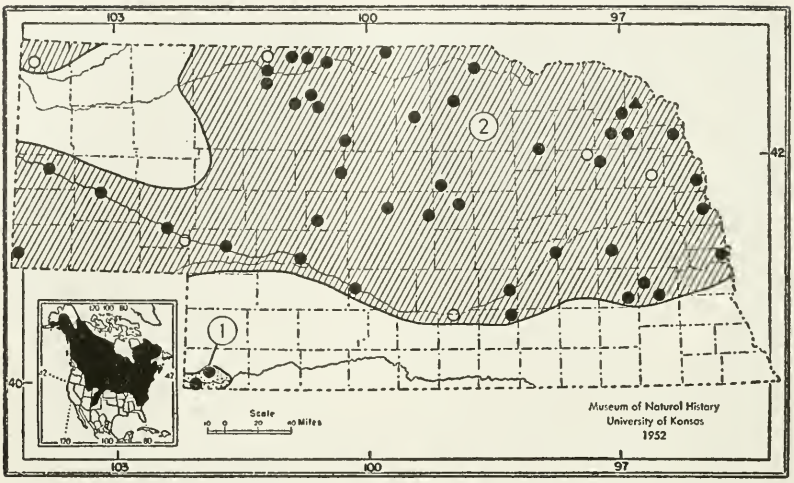

FIG. 48. Distribution of *Microtus pennsylvanicus* in Nebraska. 1. *M. p. finitus*. 2. *M. p. pennsylvanicus*. For explanation of symbols see Fig. 5.

the drier places. This situation prevails, for example, along Rock Creek in Dundy County and along the Middle Loup River, 1 mi. W Halsey. The prairie vole occupies lush, semi-marshy habitats in the absence of *pennsylvanicus* but *ochrogaster* is excluded from such areas where the two species are in direct competition. *M. pennsylvanicus* is easily distinguished externally from *M. ochrogaster* by its dark, brownish black upper parts and grayish, rather than buffy, venter.

Only 12 pregnant females of the meadow vole have been recorded from Nebraska. These, collected in the months of April, May, and July, carried an average of 6.2 (4-9) embryos.

Microtus pennsylvanicus finitus Anderson

Microtus pennsylvanicus finitus Anderson, Univ. Kansas Publ., Mus. Nat. Hist., 9:96, May 10, 1956 (type locality, 5 mi. N, 2 mi. W Parks, Dundy Co., Nebraska); Hall and Kelson, The mammals of North America, p. 726, March 31, 1959.

Microtus pennsylvanicus modestus, Hall and Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 5:410, January 15, 1953; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:486, April 21, 1954.

Microtus pennsylvanicus, Findley, Ecology, 35:418, July, 1954.

M[icrotus]. p[ennsylvanicus]. finitis [sic], Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Microtus pennsylvanicus finitis [sic], Jones, Univ. Kansas Publ., Mus. Nat. Hist., 9:388, May 19, 1958.

Distribution in Nebraska.—Known only from the Republican River drainage in western Dundy County. See Fig. 48.

External measurements.—Average and extreme measurements of 20 specimens (nine males, 11 females) from the type locality are: 167.4 (155-187); 42.1 (35-50); 22.0 (21-24); 12.5 (11-16). For cranial measurements see Table 16.

Nine specimens (four males, five females) from the type locality weighed an average of 57.2 (42.9-75.0) grams.

Remarks. — From *Microtus pennsylvanicus pennsylvanicus* of northern Nebraska, from which it is geographically isolated, *M. p. finitus* differs in larger size (both external and cranial), darker color, larger molar teeth, and longer molar tooth-rows (see Anderson, 1956:96). I am especially impressed by the dark color of *finitus.*

M. p. finitus is known only from the valley of the Republican River in western Dundy County and adjacent Yuma County, Colorado, where it inhabits restricted lowland areas at certain places along the river and at least one of its tributaries, Rock Creek. The population of meadow voles along the Republican is a relic of the more southerly distribution of the species *pennsylvanicus* in Wisconsin and post-Wisconsin times. Another microtine, *Synaptomys cooperi,* also has a relict subspecies in the same area.

Records of occurrence.—Specimens examined, 36 as follows: 5 mi. N, 2 mi. W Parks, 34; Haigler, 2 (USNM).

Microtus pennsylvanicus pennsylvanicus (Ord)

Mus Pennsylvanica Ord, *in* Guthrie, A new geographical, historical and commercial grammar . . ., ed. 2, 2:292, 1815 (type locality, meadows below Philadelphia, Philadelphia Co., Pennsylvania).

M[icrotus]. pennsylvanicus, Rhoads, Amer. Nat., 29:940, October, 1895.

Arvicola (Myonomes) riparius, Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:156, August, 1877.

Avicola [sic] riparius, Aughey, Sketches of the physical geography and geology of Nebraska, p. 121, 1880.

Microtus (Microtus) pennsylvanicus, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:249, November, 1896.

Microtus pennsylvanicus, V. Bailey, N. Amer. Fauna, 17:16, June 6, 1900; Elliot, Field Columb. Mus., Zool. Ser. (Publ. 115), 8:287, 1907; Swenk, Proc. Nebraska Acad. Sci., 8:104, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:48, September, 1908.

?*Microtus modestus,* Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902.

?*Microtus pennsylvanicus modestus,* Swenk, Proc. Nebraska Acad. Sci., 8:104, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:48, September, 1908; Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

Microtus pennsylvanicus pennsylvanicus, Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:18, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:27, October, 1936; Whelan, Trans. Kansas Acad. Sci., 39:366, 1937; Hall and Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 5:410, January 15, 1953; Jones, Univ. Kansas Publ., Mus.

Nat. Hist., 7:485, April 21, 1954; Hall and Kelson, The mammals of North America, p. 727, March 31, 1959.

M[icrotus]. p[ennsylvanicus]. pennsylvanicus, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Distribution in Nebraska.—Northern part of state, west to Wyoming border certainly in Platte drainage; south at least to Adams and Lancaster counties. See Fig. 48.

External measurements.—Average and extreme measurements of 15 specimens (four males, 11 females) from Burt, Thurston, and Wayne counties are: 164.9 (157-172); 44.5 (38-50); 20.9 (19.5-22); 11.7 (11-13). For cranial measurements see Table 16.

A male from Holt County weighed 59.5 grams. Two males and a female from Thomas County weighed, respectively, 57.3, 50.7 and 49.7 grams.

Remarks.—For comparison with *Microtus pennsylvanicus finitus* of Dundy County, see account of that subspecies. According to V. Bailey (1900:17), specimens of *M. p. pennsylvanicus* from "the plains of Nebraska and South Dakota" are somewhat paler than specimens from farther to the east.

M. p. pennsylvanicus does not occur south of the drainage of the Platte River in Nebraska excepting in the eastern part of the state where it is known from three localities in the northern part of the Blue River drainage. The range of the subspecies in the state approximates that of *Sorex cinereus haydeni.* Cary's (1902:69) record of "*Microtus modestus*" from northern Sioux County, the basis for Swenk's (1908:104 and elsewhere) reference to *Microtus pennsylvanicus modestus* from Nebraska, is questionably assigned to the present subspecies. According to Swenk (*loc. cit.*), Cary "found a single colony of this form in a little marsh on Monroe Creek . . . about two miles from the base [north of] the Pine Ridge." On the basis of geographical probability, meadow voles from Sioux County would be referable to the subspecies *M. p. insperatus,* which occurs in adjacent South Dakota, but, unfortunately, Cary preserved no specimens. That Cary's report referred to voles of the species *M. pennsylvanicus* seems unquestionable because he also recorded *M. ochrogaster* from the same area. Considerable field work has been done in northern Sioux County since Cary's visit to the area in 1901, but only *M. ochrogaster* has been taken, and the small colony of *pennsylvanicus* found by Cary may have been extirpated since then.

M. p. pennsylvanicus is fairly uniform in color throughout its range in Nebraska and fairly uniform in size except for specimens from certain localities on the Sand Hills. These, on the basis of material now available, appear to average larger than individuals from elsewhere in the state. Additional collections from some of

the semi-isolated lakes in the Sand Hills are needed before this variation can be analyzed properly. The individuals that I have examined from the lakes in Cherry County do not support Swenk's (1908:104) contention that voles from there are darker than those from other parts of the range of the subspecies in the state.

Records of occurrence.—Specimens examined, 253, as follows: ADAMS COUNTY: 4 mi. N, 2 mi. E Hastings, 1 (UNM). ANTELOPE COUNTY: 1 mi. SW Neligh, 1. BURT COUNTY: 1 mi. E Tekamah, 14. BUTLER COUNTY: 5 mi. E Rising City, 6. CEDAR COUNTY: 4 mi. SE Laurel, 1. CHERRY COUNTY: Kilgore, 1 (UNDZ); W of Crookston, 2 (NSM); Valentine, 2 (USNM); *Ft. Niobrara Nat'l Wildlife Refuge,* 1 (NSM); *3 mi. SSE Valentine,* 1; Niobrara River, 10 mi. S Cody, 1 (NSM); Two Mile Lake (sec. 12, R. 34 W, T. 31 N), 5 (3 NSM, 2 USNM); *Watt's Lake, Valentine Nat'l Wildlife Refuge,* 1 (UC); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 9 (3 UMMZ); *Dewey Lake, Valentine Nat'l Wildlife Refuge,* 4; *N shore Pelican Lake,* 1 (NGFPC); Kennedy, 4 (UMMZ); *2 mi. E Kennedy,* 2; Sweetwater Lake, Valentine Nat'l Wildlife Refuge, 1; 30 mi. S Woodlake, 2 (CNHM); *no specific locality,* 1 (USNM). CUSTER COUNTY: Victoria Springs, 1 (UMMZ); Comstock, 17 (3 AMNH, 14 NSM). DAWSON COUNTY: ½ mi. S Gothenburg, 1; *3 mi. ESE Gothenburg,* 1; *4 mi. S Gothenburg,* 1. DIXON COUNTY: no specific locality, 3. GARDEN COUNTY: ½ mi. S Oshkosh, 6. GARFIELD COUNTY: ½ mi. N Burwell, 5 (UNM). HALL COUNTY: 6 mi. S Grand Island, 2. HOLT COUNTY: 6 mi. N Midway, 1; 1 mi. S Atkinson, 6 (4 NSM). KEITH COUNTY: 4 mi. WNW Keystone, 2. KEYA PAHA COUNTY: 12 mi. N Springview, 4; *12 mi. WNW Springview,* 3. KIMBALL COUNTY: Smeed, 1. LANCASTER COUNTY: 9 mi. NW Lincoln, 6; Lincoln, 7 (1 AMNH, 6 UC). LINCOLN COUNTY: 2 mi. N North Platte, 13. LOGAN COUNTY: 1-2 mi. NE Stapleton, 46. MADISON COUNTY: *4½ mi. SSE Norfolk,* 1. MERRICK COUNTY: 2 mi. S Clarks, 1. MORRILL COUNTY: Bridgeport, 2 (NSM). POLK COUNTY: *15 mi. W Osceola,* 2. ROCK COUNTY: Perch, 19 (16 AMNH, 3 CNHM). SARPY COUNTY: Ft. Crook, 1 (AMNH). SCOTTS BLUFF COUNTY: Scottsbluff, 1 (HM). SEWARD COUNTY: Milford, 1 (UNDZ). STANTON COUNTY: 8 mi. SE Norfolk, 1. THURSTON COUNTY: 1 mi. S Winnebago, 14. THOMAS COUNTY: 1 mi. W Halsey, 8. VALLEY COUNTY: 2½ mi. N Ord, 5. WASHINGTON COUNTY: Blair, 4 (1 UMMZ, 3 USNM). WAYNE COUNTY: 2 mi. SE Carroll, 3 (NSM); Wayne, 2; *2½ mi. E Wayne,* 1.

Additional records: CHERRY COUNTY: Cody (Swenk, 1908:104). CUMING COUNTY: West Point (Swenk, 1908:104). GARDEN COUNTY: Ash Hollow, 3 mi. SE Lewellen (Champe, 1946:44—archeological site). KEARNEY COUNTY: Ft. Kearney (Coues, *in* Coues and Allen, 1877:176). LINCOLN COUNTY: *North Platte* (Swenk, MS). MADISON COUNTY: Norfolk (Swenk, 1908:104). SIOUX COUNTY: Monroe Creek (Swenk, 1908:104—questionably applies to this subspecies).

Microtus pinetorum

Woodland Vole

The woodland vole is restricted in Nebraska to the southeastern part of the state, where it inhabits, for the most part, areas of deciduous timber. Wooded slopes, like those along the bluffs of the Missouri River, having a good ground-cover of leaves and rotting logs seem to constitute the preferred habitat, but individuals have been trapped along with *Microtus ochrogaster* and *Synaptomys cooperi* in brushy fence rows some distance from timber, indicating

that the species is not restricted to wooded places. A record from Nebraska City (Cary, MS) is the northernmost in the state but *M. pinetorum* probably occurs north along the Missouri at least as far as Omaha, for it has been reported from the Iowa side at Council Bluffs (V. Bailey, 1900:66).

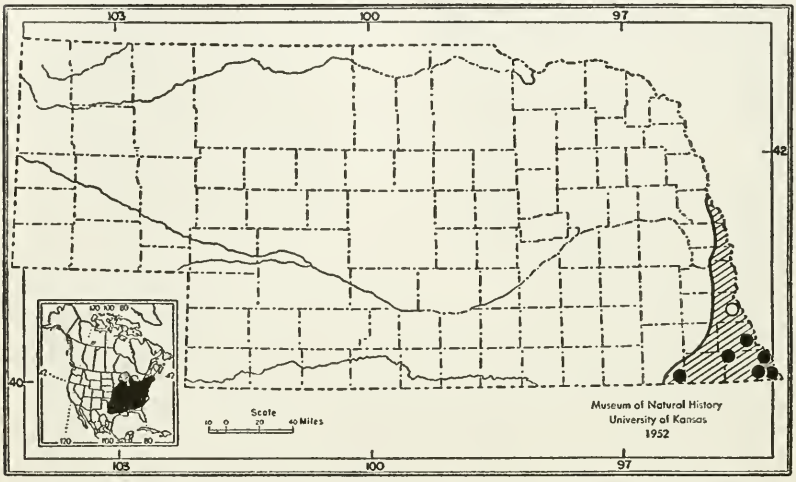

FIG. 49. Distribution of *Microtus pinetorum nemoralis* in Nebraska. For explanation of symbols see Fig. 5.

Microtus pinetorum is a member of the subgenus *Pitymys*, which has member species in both the Palearctic and Nearctic regions and which for many years was accorded generic rank—see Hinton (1926), Ellerman (1941), and others (although Miller, 1896, and V. Bailey, 1900, both regarded it as a subgenus of *Microtus*). More recently, Hall and Cockrum (1953) again reduced *Pitymys* to subgeneric rank under *Microtus* because of the cranial resemblance of New World members to voles of the subgenus *Pedomys* (which includes *M. ochrogaster*) and I tentatively follow their arrangement. *M. pinetorum* is easily distinguished externally from *M. ochrogaster* in having reddish or reddish brown upper parts, smaller ears and tail (see measurements), soft, molelike pelage, and (in females) four rather than six mammae. Cranially, in Nebraska at least, adults of *pinetorum* usually differ from adults of *ochrogaster* as follows: skull and mandible generally smaller and weaker, having less well-developed crests and ridges; coronoid and angular processes of mandible shorter; auditory bullae larger; interorbital region and interparietal relatively (usually actually) broader; m1 having only

TABLE 16.—CRANIAL MEASUREMENTS OF FOUR SPECIES OF MICROTINES

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Lamdoidal breadth	Length of nasals	Depth of skull	Length of maxillary tooth-row
Synaptomys cooperi gossii, Richardson County							
79080 KU, ♂	29.8	18.5	3.6	14.4	8.3	11.9	7.7
79178 KU, ♂	29.6	17.7	3.2	14.0	8.5	12.3	7.8
¼ mi. W Homestead Nat'l Mon., Gage County							
80141 KU, ♂	29.7	18.0	3.7	13.9	8.0	11.7	7.8
80142 KU, ♀	30.6	18.3	3.3	13.8	7.9	11.8	8.3
6 mi. N Midway, Holt County							
78379 KU, ♂	30.2	18.4	2.9	14.2	8.0	11.7	8.0
Synaptomys cooperi relictus, type locality							
51617 KU, ♀ (type)	29.3	18.2	3.1	14.1	8.1	11.9	8.5
72603 KU, ♀	29.2	17.9	3.3	13.8	8.1	11.9	8.4
Microtus ochrogaster haydenii, Cherry County							
Average 23 (5♂, 18♀)	28.8	16.4	3.8	12.5	8.3	11.4	6.8
Minimum	27.6	15.7	3.5	11.8	7.2	10.9	6.3
Maximum	30.6	17.6	4.3	13.5	8.9	12.2	7.2
Scotts Bluff County							
Average 14 (7♂, 7♀)	28.2	16.1	3.9	12.2	8.3	11.0	6.6
Minimum	27.3	15.2	3.6	11.6	7.4	10.6	6.3
Maximum	28.9	17.1	4.1	12.7	9.0	11.4	7.0
Microtus ochrogaster ochrogaster, Richardson County							
Average 15 (10♂, 5♀)	28.1	16.2	4.1	12.5	7.8	11.0	6.5
Minimum	26.8	15.5	3.8	12.1	7.3	10.5	6.3
Maximum	29.0	16.6	4.4	13.0	8.4	11.8	6.9
Microtus pennsylvanicus finitus, type locality							
Average 15 (7♂, 8♀)	29.8	16.3	3.5	12.4	8.1	11.7	7.5
Minimum	28.3	15.4	3.1	11.8	7.4	11.1	7.2
Maximum	31.5	17.4	3.8	13.4	9.0	12.4	8.0
Microtus pennsylvanicus pennsylvanicus, northern Nebraska							
Average 10 (7♂, 3♀)	29.7	16.4	3.6	12.7	8.0	11.6	7.4
Minimum	28.5	15.9	3.4	12.0	7.5	10.7	6.8
Maximum	30.5	17.1	3.8	13.4	8.4	12.6	8.0
Microtus pinetorum nemoralis, London, Nemaha County							
52783 USNM, ♀	26.0	16.1	4.0	.....	7.0	10.2	6.5
52784 USNM, ♂	25.3	15.9	4.2	12.7	7.6	.....	6.1
52785 USNM, ♂	26.4	16.1	4.4	13.2	7.6	10.3	6.3
53921 USNM, ♂	25.3	15.4	4.2	12.5	7.2	9.9	6.2
5 mi. N, 2 mi. W Humboldt, Richardson County							
79079 KU, ♀	26.5	16.2	4.3	11.9	8.0	10.5	6.7

three closed triangles in front of posterior loop instead of four. Differences between the glans penis and baculum also are known.

A female taken on December 1, 1957, carried 3 embryos, another trapped on August 27, 1958, carried 2, and a young adult female obtained on April 20, 1958, also had 2.

Microtus pinetorum nemoralis V. Bailey

Microtus pinetorum nemoralis V. Bailey, Proc. Biol. Soc. Washington, 12:89, April 30, 1898 (type locality, Stilwell, Adair Co., Oklahoma); Hall and Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 5:449, January 15, 1953; Hall and Kelson, The mammals of North America, p. 750, March 31, 1959.

A[rvicola]. pinetarum [sic], Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Microtus nemoralis, V. Bailey, N. Amer. Fauna, 17:65, June 6, 1900; Swenk, Proc. Nebraska Acad. Sci., 8:102, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:46, September, 1908.

Pitymys nemoralis, Swenk, Nebraska Blue Book, p. 852, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Jones and Webb, Jour. Mamm., 30:312, August 17, 1949.

M[icrotus]. p[inetorum]. nemoralis, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Distribution in Nebraska.—Southeastern part of state, north along Missouri certainly to Otoe County and probably at least to Douglas County. See Fig. 49.

External measurements.—Average and extreme measurements of nine specimens (six males, three females) from southeastern Nebraska are: 134.0 (127-140); 25.1 (20-28); 19.2 (18-20.5); 11.9[4] (11-12.5). For cranial measurements see Table 16.

Cockrum (1952:201) recorded the respective weight in grams of three males and two females from Douglas County, Kansas, as 28.6, 35.0, 44.3, 27.3, and 39.6.

Records of occurrence.—Specimens examined, 13, as follows: GAGE COUNTY: 2 mi. S, ½ mi. E Barnston, 2. NEMAHA COUNTY: London, 6 (USNM). RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 1; Barada, 1 (NSM); 2 mi. N Falls City, 1; 5 mi. SE Rulo, 2 (1 NGFPC).

Additional record: OTOE COUNTY: Nebraska City (Cary, MS).

Ondatra zibethicus

Muskrat

The semi-aquatic muskrat occurs in suitable habitat throughout Nebraska—in nearly all places where permanent water is found. Although common along many of the larger rivers, especially in the eastern part of the state, the species is commonest in the lake region of the Sand Hills, where hundreds of thousands inhabit the lakes and marshes.

According to Sather (1958), whose "Biology of the Great Plains muskrat in Nebraska" is recommended to the reader, the muskrat

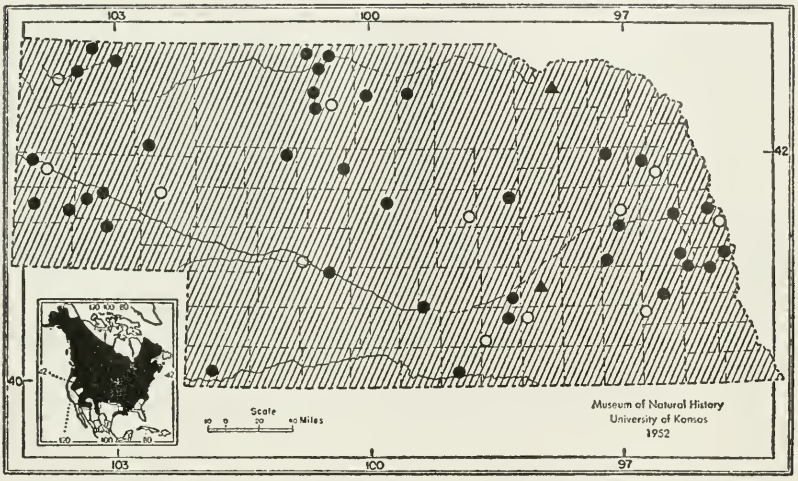

FIG. 50. Distribution of *Ondatra zibethicus cinnamominus* in Nebraska. For explanation of symbols see Fig. 5.

has been the most important fur-bearer in Nebraska, both in numbers harvested and total monetary value. His estimate of the number of muskrats harvested in Nebraska and the value of the harvest for the years 1950, 1951, and 1952, respectively, was as follows: 165,104 and $211,333; 209,544 and $322,698; 367,921 and $257,545. The relatively low prices paid for muskrat pelts in recent years, and reduced numbers in some areas, have made large-scale trapping less appealing than formerly.

From 1949 to 1952 on the Valentine National Wildlife Refuge, Sather (*op. cit.*:31) found that the breeding season extended from late April to early September; adult females produced 2.5 (1-4) litters annually with an average of 6.0 (1950) to 6.5 (1951) young per litter (counts of placental scars slightly higher). Few females breed in their first year; those that do so have a smaller number of young per litter than do adults.

Ondatra zibethicus cinnamominus (Hollister)

Fiber zibethicus cinnamominus Hollister, Proc. Biol. Soc. Washington, 23: 125, September 2, 1910 (type locality, Wakeeney, Trego Co., Kansas); Hollister, N. Amer. Fauna, 32:30, April 29, 1911; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920.

Ondatra zibethica cinnamomina, Miller, Bull. U. S. Nat. Mus., 79:232, December 31, 1912; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:30, October, 1936.

Ondatra Zibethicus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Fiber zibethicus, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:105, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:49, September, 1908 (part).

Fiber zibethicus pallidus, Swenk, Proc. Nebraska Acad. Sci., 8:106, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:50, September, 1908 (part).

Fiber zibethicus cinnamomina, Swenk, Nebraska Blue Book, p. 852, 1915.

Ondatra z[ibethica]. cinnamomina, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Ondatra zibethica, Jones, Nebraska Bird Rev., 20:10, January, 1952.

Ondatra zibethica cinnamominus, Sather, Nat. Hist. Misc., Chicago Acad. Sci., 130:2, March 8, 1954.

Ondatra zibethicus cinnamominus, Sather, Jour. Mamm., 37:501, January 9, 1957; Sather, Wildlife Monog., 2:1, May, 1958.

O[ndatra]. z[ibethicus]. cinnamominus, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 50.

External measurements.—Average and extreme measurements of eight specimens (four males, four females) from southeastern Nebraska are: 544.0 (515-578); 242.9 (225-252); 76.6 (71-81). Corresponding measurements of four females from northwestern Nebraska, followed by measurements of a male from Dundy County are: 553.2 (525-571), 532; 246.0 (232-267), 250; 77.7 (73-81), 72; 22.5[2] (20-25), 23. For cranial measurements see Table 17 and Sather (1957).

Sather (1958:13) reported the average weight of 198 males from the Valentine National Wildlife Refuge as 2.6 lbs. (1.6-3.4), and that of 215 females as 2.4 lbs. (1.7-3.2).

Remarks.—I tentatively follow Hollister (1911) in referring muskrats from throughout Nebraska to the subspecies *O. z. cinnamominus* even though some geographic variation is apparent in the specimens studied. Some individuals from eastern Nebraska are darker than topotypes, possibly reflecting intergradation with *O. z. zibethicus,* whereas some individuals from the Sand Hills are noticeably paler than topotypes (especially noteworthy in this regard are four May-taken specimens from 4 mi. E Antioch). Most of the skins I have examined, however, are fairly typical of *cinnamominus.* Swenk (1908:104-105) recognized that muskrats from the northwestern part of the state averaged paler than those from the eastern part and referred specimens from Nebraska to two different subspecies.

No consistent differences in linear measurements, either external or cranial, were found between specimens from eastern and western Nebraska. On the average, however, specimens available from western Nebraska (Cherry and Dundy counties for example) have slightly more procumbent incisors, larger nasolacrimal capsules, and more arched (less flattened) dorsal surface of skull in lateral

view than do specimens studied from eastern Nebraska (Butler County for example). In these particulars the specimens from western Nebraska resemble topotypes of *cinnamominus*. Also, to judge from Nebraskan specimens, *O. z. cinnamominus* is only slightly, if at all, smaller than *O. z. zibethicus*, contrary to Hollister's (1911:30) claim.

Despite the relatively large number of specimens listed herein, additional material from Nebraska is needed for study because most of the specimens now available are skulls alone and many of these lack data as to sex and external measurements. When only adults (as described by Sather, 1954) of known sex are considered, the resultant number of available specimens is so small and the geographic representation so spotty that meaningful analysis of variation is impossible. A study based on adequate material of geographic variation in *Ondatra zibethicus* on the Great Plains and adjacent regions is needed.

Records of occurrence.—Specimens examined, 292, as follows: ADAMS COUNTY: Hastings, 2 (HM). BANNER COUNTY: Harrisburg, 1 (NSM); 8 mi. SW Redington, 1 (NSM). BROWN COUNTY: Johnstown, 27 (USNM); *1 mi. W Long Pine*, 22 (AMNH). BUFFALO COUNTY: Elm Creek, 1. BUTLER COUNTY: Platte River, 7; *Bone Creek*, 2 (MVZ); Blue River, 2 (MVZ). CASS COUNTY: Louisville, 1 (NSM). CHERRY COUNTY: W of Crookston, 1 (NSM); Valentine, 3 (1 UMMZ, 2 UNDZ); *Ft. Niobrara Nat'l Wildlife Refuge*, 4 (NSM); 7 mi. SW Valentine, 1 (MVZ); *Trout Lake*, 1 (UMMZ); Hackberry Lake, 2 (UMMZ); *Valentine Nat'l Wildlife Refuge*, 14 (NSM); Rat Lake, 11 (NSM). CHEYENNE COUNTY: Dalton, 1 (NSM). CUMING COUNTY: Beemer, 10 (USNM). CUSTER COUNTY: Victoria Springs, 1 (UMMZ). DAWES COUNTY: Wayside, 1; Chadron, 1 (NSM); Crawford, 1 (NSM). DODGE COUNTY: Fremont, 2 (NSM). DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 1; *Rock Creek, N of Parks*, 11. FRANKLIN COUNTY: Franklin, 1 (NSM). GREELEY COUNTY: near Spaulding, 1 (NSM). HALL COUNTY: *Alda Bridge, W of Doniphan*, 1 (HM); Doniphan, 1 (HM). HAMILTON COUNTY: no specific locality, 1 (HM). HOOKER COUNTY: Kelso, 1 (UMMZ). KEYA PAHA COUNTY: *Niobrara River*, 8 (AMNH). KNOX COUNTY: no specific locality, 1 (NSM). LANCASTER COUNTY: *5½ mi. NW Lincoln*, 1 (UNDZ); *2 mi. N Lincoln*, 1 (NSM); Lincoln, 17 (1 NGFPC, 12 NSM, 2 UC, 2 UNDZ). LINCOLN COUNTY: W of Brady, 1 (NSM). MORRILL COUNTY: Bridgeport, 74 (NSM); 4 mi. S, 9 mi. W Bridgeport, 1 (NSM). ROCK COUNTY: 1 mi. E Bassett, 1 (UC); *Skull Creek, 30 mi. S Bassett*, 18 (AMNH); *Johnson Ranch, Skull Creek*, 9 (AMNH). SARPY COUNTY: Bellevue, 1 (RV). SAUNDERS COUNTY: Memphis State Lake, 3 (UNDZ); Ashland, 1 (NSM). SCOTTS BLUFF COUNTY: Mitchell, 1 (NSM). SHERIDAN COUNTY: *McFall Lake, near Antioch*, 1 (NGFPC); 4 mi. E Antioch, 4 (NSM). STANTON COUNTY: 7 mi. E Norfolk, 1. THOMAS COUNTY: Halsey, 1 (NSM). WASHINGTON COUNTY: 1¼ mi. N Blair, 1 (UC); *Blair*, 6 (RV). County unknown: *Nebraska*, 2 (NGFPC).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). CHERRY COUNTY: *North Marsh Lake, Valentine Nat'l Wildlife Refuge* (Jones, 1952:10); several lakes on Valentine Nat'l Wildlife Refuge, including Twenty-one Lake (Sather, 1958:1-5). CLAY COUNTY: vicinity Inland (Swenk, MS). COLFAX COUNTY: 8 mi. NW Schuyler (record on file, NGFPC). CUMING COUNTY: West Point (Swenk, MS). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272). LANCASTER COUNTY: 3 mi. E Crete (record on file, NGFPC). LINCOLN COUNTY: near North Platte (Swenk, MS). SCOTTS

BLUFF COUNTY: Scotts Bluff Nat'l Mon. (Mattes, 1958:57). SIOUX COUNTY: White River, near Glen (Swenk, 1908:105). VALLEY COUNTY: ¾ mi. N, 6 mi. W North Loup (Hill and Kivett, 1941:183—archeological site). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823.369).

TABLE 17.—CRANIAL MEASUREMENTS OF ONDATRA ZIBETHICUS CINNAMOMINUS.

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Length of nasals	Breadth of rostrum	Length of maxillary tooth-row	Depth of skull
Southeastern Nebraska							
51612 MVZ, ♂	63.7	39.7	6.5	21.8	14.1	14.9	.....
1865 NSM, ♂	62.8	37.8	5.5	21.6	13.3	14.9	24.3
3437 NSM, ♀	61.4	38.8	6.0	20.9	13.2	16.1	25.2
75120 KU, ♀	63.3	41.2	6.7	21.2	13.8	14.5	25.7
75122 KU, ♀	63.7	39.0	6.4	20.9	13.2	14.5	25.7
Bridgeport, Morrill County							
Average 7 (♂)	62.6	39.6	6.1	21.0	13.6	15.8	25.6
Minimum	60.5	37.8	5.8	19.1	12.7	15.3	25.0
Maximum	64.8	41.1	6.6	22.2	14.5	16.1	26.6
Average 6 (♀)	62.8	38.1	5.6	21.0	13.3	15.8	24.8
Minimum	61.0	36.3	5.1	19.9	12.7	15.0	23.7
Maximum	64.4	39.4	6.1	21.8	14.0	16.6	25.7

Family ZAPODIDAE—Jumping Mice

Zapus hudsonius

Meadow Jumping Mouse

In the western part of its range in Nebraska *Zapus hudsonius* is found only in the riparian communities that border rivers and lakes, often isolated from other areas of suitable habitat by many miles of inhospitable terrain. In the eastern part of the state the species is more generally distributed and occurs in riparian situations, at the borders of woodland, and on lush upland prairies. The meadow jumping mouse hibernates in winter.

Krutzsch (1954:429) reported that 62 pregnant females from throughout the range of the species carried an average of 5.4 (2-8) embryos and indicated that two litters per year was the rule. Breeding in late summer in Nebraska is indicated by lactating females from Cherry County taken on August 9, 1960, and September 4, 1952.

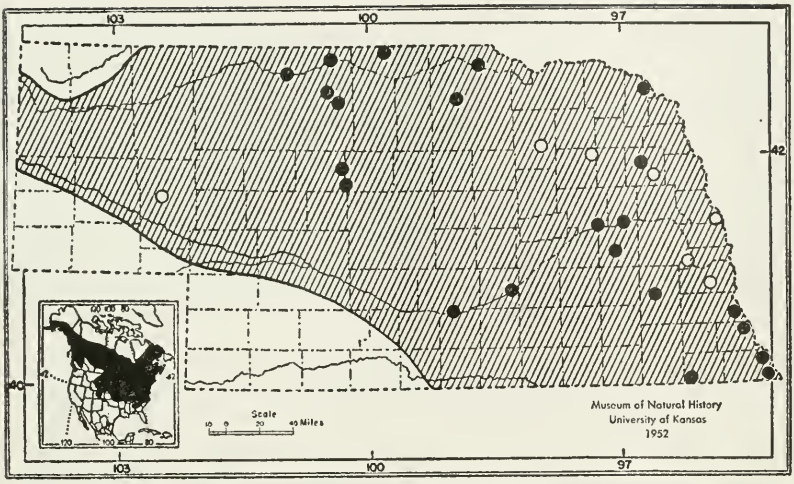

FIG. 51. Distribution of *Zapus hudsonius pallidus* in Nebraska. For explanation of symbols see Fig. 5.

Zapus hudsonius pallidus Cockrum and Baker

Zapus hudsonius pallidus Cockrum and Baker, Proc. Biol. Soc. Washington, 63:1, April 26, 1950 (type locality, 5½ mi. N, 1¾ mi. E Lawrence, Douglas Co., Kansas); Jones, Jour. Mamm., 31:454, November 21, 1950; Krutzsch, Univ. Kansas Publ., Mus. Nat. Hist., 7:450, April 21, 1954; Hall and Kelson, The mammals of North America, p. 773, March 31, 1959.

Gerbillus Canadensis, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Jaculus hudsonius, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1): 430, July 14, 1858.

Zapus hudsonius, Coues, Bull. U. S. Geol. Surv. Territories, 1(2nd ser., no. 5):254, 1876; Coues, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:254, August, 1877.

Zapus Hudsonius, Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880.

Zapus hudsonius campestris, Preble, N. Amer. Fauna, 15:20, August 8, 1899; Swenk, Proc. Nebraska Acad. Sci., 8:111, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:55, September, 1908; Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 481, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:26, October, 1936; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949.

Zapus h[udsonius]. campestris, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Z[apus]. h[udsonius]. pallidus, Jones, Trans. Kansas Acad. Sci., 60:278, October 22, 1957.

Distribution in Nebraska.—Eastern and central parts of state, west certainly to Garden County. See Fig. 51.

External measurements.—Average and extreme measurements of four males from southeastern Nebraska are: 201.0 (196-207); 119.2 (115-127); 27.9 (26-29.5); 13.1 (13-13.5). Corresponding measurements for nine specimens (five males, four females) from Cherry County are: 206.6 (194-220); 119.7 (112-131); 29.1 (28-30); 12.6 (12-13.5). For cranial measurements see Table 18.

Two males from Pawnee County weighed 20.5 and 16.5 grams. Six specimens (five males and a female) from Cherry County averaged 18.8 (16.5-22.1) grams.

Remarks.—Specimens from southeastern Nebraska are typical of *Z. h. pallidus*. In the northeast, specimens from Cuming and Dixon counties are intergrades with *Z. h. intermedius* as pointed out by Krutzsch (1954:451) and the same is true to a lesser extent of specimens from Boyd and Holt counties.

Specimens from the Sand Hills of Cherry County and from adjacent Keya Paha, Thomas, and Blaine counties average larger in most external and cranial measurements than typical *pallidus* and in this respect approach *Z. h. campestris* of southwestern South Dakota and adjacent Wyoming. In color, however, these specimens resemble *pallidus* (and thus differ strikingly from *campestris*) but are paler dorsally, especially on the sides, which are yellowish in over-all appearance rather than yellowish orange (lateral line near ochraceous-buff rather than cinnamon-buff). If additional specimens confirm the relatively large size and pale color of *Z. hudsonius* on the Sand Hills of Nebraska, subspecific recognition may be warranted for this population.

No jumping mice are available from the Pine Ridge or adjacent areas in northwestern Nebraska where the subspecies *Z. h. campestris* may occur. Similarily, no Nebraskan specimens are available from the western part of the Platte drainage where the subspecies *Z. h. preblei* possibly occurs; it is known presently from as near Nebraska as Chugwater, Wyoming (Krutzsch, 1954:453).

One specimen examined (KU 87043), an adult female, lacked P4 on the right side and had no trace of an alveolus to suggest that a permanent tooth ever had been present.

Records of occurrence.—Specimens examined, 46, as follows: BLAINE COUNTY: Dismal River, 2 mi. S, 8 mi. W Dunning, 1; *Dismal River, Thomas-Blaine counties line*, 1 (NGFPC). BOYD COUNTY: 5 mi. S, 2 mi. E Spencer, 1. BUTLER COUNTY: 5 mi. E Rising City, 1. CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge, 1 (NSM); *3 mi. SSE Valentine*, 1; Niobrara River, 18 mi. NW Kennedy, 2; *Ballard Marsh, 20 mi. S Valentine*, 1 (NGFPC); Watt's Lake, Valentine Nat'l Wildlife Refuge, 2; *Hackberry Lake, Valentine Nat'l Wildlife Refuge*, 5; *Dewey Lake, Valentine Nat'l Wildlife Refuge*, 7; Pony Lake, Valentine Nat'l Wildlife Refuge, 1. COLFAX COUNTY: 2 mi. S Schuyler, 1. CUMING COUNTY: Beemer, 4 (USNM). DIXON COUNTY: 3 mi. NE Ponca, 1. HALL COUNTY: 6 mi. S Grand Island, 1. HOLT COUNTY: 1 mi. S Atkinson,

2. KEARNEY COUNTY: Platte Meadows, Kearney, 1 (HM). KEYA PAHA COUNTY: 12 mi. NNW Springview, 1. LANCASTER COUNTY: Lincoln, 1 (NSM). NEMAHA COUNTY: Peru, 1 (AMNH). OTOE COUNTY: 3 mi. S, 2 mi. E Nebraska City, 1. PAWNEE COUNTY: 4 mi. S, 8 mi. W Pawnee City, 2. PLATTE COUNTY: Columbus, 1 (USNM). RICHARDSON COUNTY: 4 mi. E Barada, 2; 5 mi. SE Rulo, 2 (1 NGFPC, 1 WSC). THOMAS COUNTY: Halsey, 1 (AMNH).

Additional records: ANTELOPE COUNTY: Neligh (Cary, MS). CASS COUNTY: Weeping Water (Swenk, MS). CUMING COUNTY: West Point (Swenk, 1908:111). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272). MADISON COUNTY: Norfolk (Swenk, 1908:111). SAUNDERS COUNTY: 2 mi. NE Ashland (Jones, field notes). WASHINGTON COUNTY: Engineer Cantonment [=approximately 2 mi. E Ft. Calhoun] (James, 1823:369). County unknown: *Platte River* (Coues, *in* Coues and Allen, 1877:476).

TABLE 18.—CRANIAL MEASUREMENTS OF ZAPUS HUDSONIUS PALLIDUS.

Number of specimens averaged or catalogue number, and sex	Occipitonasal length	Condylobasal length	Zygomatic breadth	Interorbital constriction	Mastoid breadth	Depth of skull	Length of maxillary tooth-row
8 mi. S, 4 mi. W Pawnee City, Pawnee County							
72205 KU, ♂	22.6	20.1	10.9	4.3	9.7	8.9	3.3
72206 KU, ♂	21.6	19.0	10.4	4.2	9.4	9.0	3.5
2 mi. S Schuyler, Colfax County							
76880 KU, ♂	21.3	18.9	10.4	4.4	9.4	8.6	3.4
1 mi. S Atkinson, Holt County							
79260 KU, ♂	21.6	19.5	10.6	4.2	9.6	8.6	3.7
Cherry County							
Average 10 (6♂, 4♀)	22.9*	20.6*	11.4	4.3	10.2*	8.9*	3.6
Minimum	22.4	19.8	10.8	4.1	9.6	8.7	3.5
Maximum	23.2	21.0	11.8	4.7	10.6	9.1	3.8

* Nine specimens only.

Family ERETHIZONTIDAE—Porcupines

Erethizon dorsatum

Porcupine

The porcupine is abundant on the Pine Ridge and in adjacent areas of northwestern Nebraska and is relatively common along the Niobrara River, along the Platte River in the Panhandle, and on the Wildcat and Bighorn ridges. The species occurs sparingly in the western part of the Republican Valley and in the Loup River drainage (except in the coniferous timber in the Bessey Division,

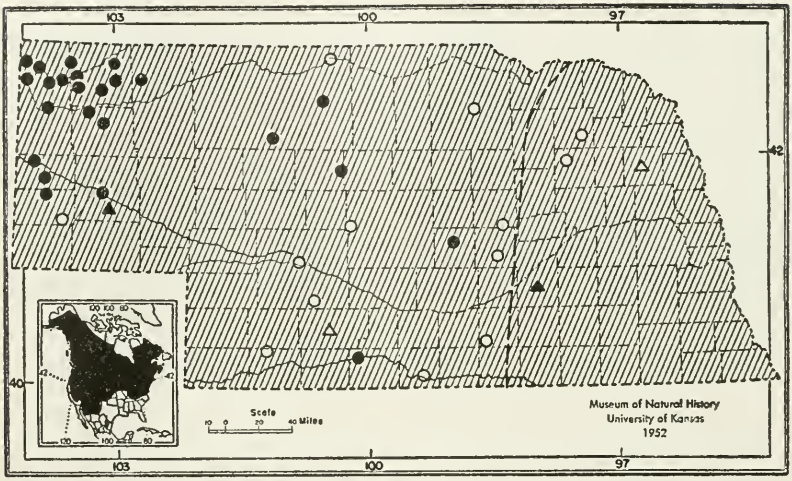

FIG. 52. Distribution of *Erethizon dorsatum bruneri* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate eastern limit of present distribution.

Nebraska National Forest, where it is numerous). Formerly the porcupine occurred farther east in Nebraska than now and may have been state-wide in distribution.

Probably the species was never common in eastern Nebraska for I have found no mention of it in historical literature dealing with that part of the state. Swenk (1916:115) wrote: "Up to about 1885 these animals occurred across the northern portion of Nebraska east at least to Pierce and Madison counties, there being records of four specimens secured along the small streams tributary to the Elkhorn river in these two counties between 1870 and 1885." Cary (MS) recorded a specimen from along the Elkhorn in Cuming County. The most easterly record of occurrence south of the Platte River is from Hamilton County. Cockrum (1952:217) recorded the possible occurrence of the species in extreme eastern Kansas, the basis for my assumption that it possibly occurred throughout Nebraska.

Females bear a single offspring, rarely twins, in spring or early summer. A spring-taken female from Dawes County carried a single embryo.

Erethizon dorsatum bruneri Swenk

Erethizon epixanthum bruneri Swenk, Univ. Nebraska Studies, 16:117, November 21, 1916 (type locality, 3 mi. E Mitchell, Scotts Bluff Co., Nebraska); Swenk, Nebraska Blue Book, p. 409, December, 1918; Swenk,

Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:23, October, 1936.

Erethizon dorsatum bruneri, Anderson, Bull. Nat. Mus. Canada, 102:173, January 24, 1947; Hall and Kelson, The mammals of North America, p. 781, March 31, 1959.

Erethizon epixanthus, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):569, July 14, 1858; Aughey, Sketches of the physical geography and geology of Nebraska, p. 122, 1880; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:112, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:56, September, 1908.

[Erethizon dorsatus] var. *epixanthus,* J. A. Allen, *in* Coues and Allen, Bull. U. S. Geol. Surv. Territories, 11:389, August, 1877.

Erethizon epixanthum epixanthum, Swenk, Nebraska Blue Book, p. 853, 1915.

E[rethizon]. d[orsatum]. bruneri, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—Western two-thirds of state at present, formerly east at least to Cuming County and probably state-wide. See Fig. 52.

Measurements.—External measurements of two males and two females from eastern Sioux County are, respectively: 842, 825, 872, 862; 210, 225, 175, 285; 106, 117, 116, 112; 37, 32, 37, 30. A female from 9 mi. N and 5 mi. E Harrisburg measured: 820; 240; 110; 35. The two males and one of the females from Sioux County weighed, respectively, 24¼, 27, and 27 pounds.

Respective cranial measurements of the five specimens listed above are: condylobasal length, 111.4, 118.2, 110.8, 114.7, 116.4; zygomatic breadth, 79.4, 73.7, 77.9, 80.6, 74.7; mastoid breadth, 48.1, 49.4, 48.1, 48.8, 49.8; rostral breadth, 25.3, 26.2, 28.2, 27.5, 24.7; interorbital constriction, 33.4, 38.5, 40.2, 38.2, 31.7; length of nasals, 38.2, ___, 40.5, 40.3, 41.6; alveolar length of maxillary tooth-row, 26.1, 26.6, 26.7, 29.5, 28.5.

Records of occurrence.—Specimens examined, 61, as follows: BANNER COUNTY: 9 mi. N, 5 mi. E Harrisburg, 1. BOX BUTTE COUNTY: 4 mi. S Marsland, 3 (NSM); Hemingford, 1 (NSM). CHERRY COUNTY: Pelican Lake, Valentine Nat'l Wildlife Refuge, 1; Roseberry Ranch, N of Mullen, 1 (NSM). DAWES COUNTY: Chadron, 4 (1 CSTC, 3 HM); near center of N ½, sec. 31, T. 33 N, R. 52 W (7 mi. N, 4 mi. W Crawford), 1 (NSM); 10 mi. S Chadron, 3 (UMMZ); 2-3 mi. W Crawford, 3 (NSM); West Ash Creek, SE of Crawford, 1 (NSM); about 15 mi. NE Marsland, 4 (NSM). FURNAS COUNTY: 1 mi. E Cambridge, 1 (NSM). HAMILTON COUNTY: no specific locality, 1 (HM). MORRILL COUNTY: Bridgeport, 1 (NSM); no specific locality, 1 (NSM). SCOTTS BLUFF COUNTY: 3 mi. E Mitchell, 1 (MVZ), the holotype; *Scottsbluff,* 1 (NSM); *Gering,* 1 (NSM); 6 mi. S Gering, 1. SHERIDAN COUNTY: Hay Springs, 1 (NSM). SHERMAN COUNTY: Loup City, 1 (HM). SIOUX COUNTY: Squaw Canyon, 4 (NSM); *Warbonnet Canyon,* 2 (UNDZ); *Monroe Canyon,* 3 (1 NGFPC, 2 NSM); *13 mi. NW Crawford,* 1 (NSM); Sowbelly Canyon, 5 mi. N Harrison, 1 (NGFPC); *Harrison,* 1 (NSM); *5½-7½ mi. W Crawford,* 7 (4 NSM); 3 mi. N Glen, 2 (NSM); 2 mi. S Harrison-Van Tassel road, about 2 mi. E Wyoming line, 1 (NSM); Andrews, 1 (NSM); *10 mi. SW Glen,* 2 (NSM); 4 mi. E Agate, 1. THOMAS COUNTY: near Halsey, 2.

Additional records: ADAMS COUNTY: 6 mi. N Bladen (Swenk, MS). BANNER COUNTY: Lawrence Fork (Kiener, 1951:237). CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge (Beed, 1936:23). CUMING COUNTY: no specific locality (Cary, MS). CUSTER COUNTY: near Arnold (Swenk, MS). FRONTIER COUNTY: no specific locality (Swenk, 1916:115). GREELEY COUNTY: N of Wolbach (Swenk, MS). HARLAN COUNTY: *Orleans* (Swenk, 1916:115);

Alma (Swenk, MS). HITCHCOCK COUNTY: E of Palisade (Swenk, MS). HOLT COUNTY: S of O'Neill (Swenk, MS). HOWARD COUNTY: S of St. Paul (Swenk, MS). LINCOLN COUNTY: W of North Platte (Swenk, 1916:116); about 10 mi. N Curtis (Swenk, MS). MADISON COUNTY: Deer Creek, W of Battle Creek (Swenk, 1908:112). PIERCE COUNTY: North Fork, 14 mi. NW Norfolk (Swenk, 1908:112). SCOTTS BLUFF COUNTY: 7 mi. N Scottsbluff (Swenk, 1916:116); *Scotts Bluff Nat'l Mon.* (Mattes, 1958:57). SIOUX COUNTY: *head of Prairie Dog Creek* (Swenk, 1908:112). County unknown: *Republican Fork [River]* (Baird, 1858:571).

Order CARNIVORA—Carnivores

Five families of Carnivora are indigenous to North America and representatives of all five occur, or occurred within historic time, in Nebraska. Seven of the 20 species native to the state, the gray wolf, black bear, grizzly bear, wolverine, otter, mountain lion, and lynx, now have been extirpated there by European man and the population of several other species is low as a result of his activities.

KEY TO FAMILIES OF NEBRASKAN CARNIVORES

1. Five toes on hind foot; caecum absent; 34 to 42 teeth; longitudinal septa lacking in auditory bullae....2
1′. Four toes on hind foot; caecum absent; 28, 30 or 42 teeth; longitudinal septa present in auditory bullae....4
2(1). Total length more than 1200; tail shorter than hind foot; alisphenoid canal present; 42 teeth....Ursidae, p. 261
2′. Total length less than 1200; tail longer than hind foot; alisphenoid canal absent; 34 to 40 teeth....3
3(2′). Tail having conspicuous rings; 40 teeth (molars 2/2); carnassials flattened....Procyonidae, p. 264
3′. Tail lacking rings; 34 to 38 teeth (molars 1/2); carnassials not flattened....Mustelidae, p. 267
4(1′). Muzzle elongate; 42 teeth; claws non-retractile....Canidae, p. 244
4′. Muzzle rounded; 28 or 30 teeth; claws retractile....Felidae, p. 299

Family CANIDAE—Coyote, Wolves and Foxes

KEY TO NEBRASKAN CANIDS

1. Total length more than 1050; condylobasal length more than 155; postorbital processes thickened and convex dorsally....2
1′. Total length less than 1050; condylobasal length less than 155; postorbital processes thin and concave dorsally....3
2(1). Total length usually more than 1400; width of rhinarium more than 25; upper canines, when viewed from the front, not extending below line drawn through anterior mental foramina of rami....*Canis lupus*, p. 249
2′. Total length usually less than 1400; width of rhinarium less than 25; upper caines, when viewed from the front, extending below line drawn through anterior mental foramina of rami....*Canis latrans*, p. 245
3(1′). Upper parts reddish; condylobasal length more than 125; length of maxillary tooth-row more than 55....*Vulpes vulpes*, p. 254
3′. Upper parts not reddish; condylobasal length less than 125; length of maxillary tooth-row less than 55....4
4(3′). Upper parts grizzled grayish; temporal ridges prominent, lyre-shaped. *Urocyon cinereoargenteus*, p. 258
4′. Upper parts yellowish brown; temporal ridges reduced, not lyre-shaped....*Vulpes velox*, p. 252

Canis latrans

Coyote

Canis latrans is state-wide in distribution and the most abundant of Nebraska's native canids, as historical evidence reveals it was when the white man first reached the state. Man has waged a destructive campaign against the coyote, mostly to prevent depredations of domestic livestock and poultry, but also for its pelt, which in certain periods up to a decade or so ago was a valuable commodity, and for sport. The methods used to kill coyotes have been varied and have met with varying success, but despite all efforts the species persists. A discussion of the merit of bounty systems, the controversial participation of the Federal Government in "control" of predators, and other aspects of the problem is not germane to this report; for those desiring information of this kind the discussions by Gier (1957:69-90) and Hall (1946:249-263) are especially

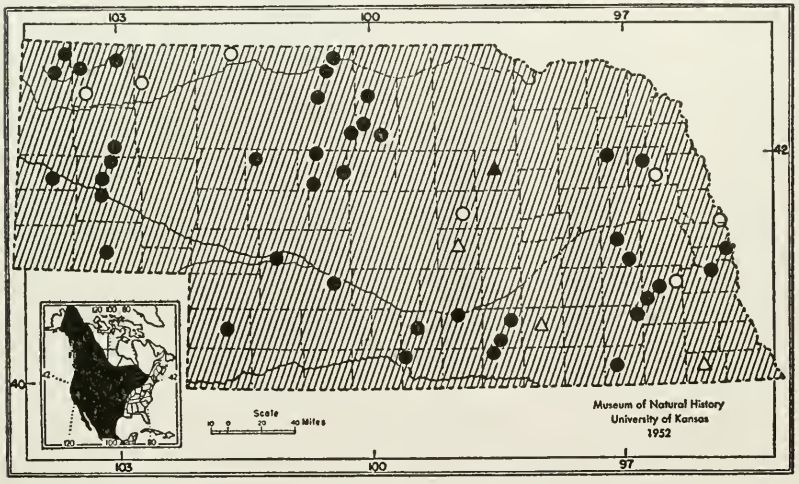

FIG. 53. Distribution of *Canis latrans latrans* in Nebraska. For explanation of symbols see Fig. 5.

recommended. Fichter *et al.* (1955:34), who made a valuable study of the food habits of *C. latrans* in Nebraska, wrote: "Suffice it to say that the coyote has long been without question looked upon as an economic liability in Nebraska and has been summarily dealt with as such, often ineffectively and uneconomically, and always without knowledge of or concern for all possible biological consequences in the wild community."

The coyote is relatively common in many places in western Nebraska that are sparsely inhabited by humans. Only in areas

where control operations have been especially vigorous is the species rare. One such place was in northwestern Sioux County and adjacent Dawes County in the summer of 1957, where in nearly two months of field work the only evidence of coyotes found was an occasional track and the skull of an individual poisoned the previous winter by a Federal predator control agent. In the eastern part of the state where the denser population of humans and domestic animals limits the use of poisoned baits, the coyote survives remarkably well and is not uncommon, especially in areas where some rough, fallow land occurs.

The coyote breeds successfully on occasion in the wild with the domestic dog (*Canis familiaris*), the resultant hybrids frequently being called "coydogs." I have received several reports of hybrid animals taken in eastern Nebraska and have examined one specimen that I judge to be a coydog. This individual was obtained in June of 1958 near Dwight; it resembled a dog more than a coyote in color (blackish with a white spot on the throat) and in having relatively short legs and an otherwise stocky build, but resembled a coyote in cranial features. Color variations of major consequence apparently are rare in full-blooded coyotes (see Young, 1951:50-53). I know of six white individuals, all with bluish eyes, that have been taken in Nebraska but there is no record of melanistic animals.

According to Gier (1957:37-38) the coyote breeds in February and March in Kansas and females bear litters in April and May after a gestation period of about 60 days. He found a range of 2-12 "term" placental scars in females that had successfully borne a litter. A female from Lancaster County carried 7 embryos when taken on March 25, 1940.

Canis latrans latrans Say

Canis latrans Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:168 (footnote), 1823 (type locality, Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], Washington Co., Nebraska); Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):113, July 14, 1858; J. A. Allen, Bull. U. S. Geol. Surv. Territories, 2(4):316, July 1, 1876; Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880; Swenk, Proc. Nebraska Acad. Sci., 8:120, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:64, September, 1908 (part); Swenk, Nebraska Blue Book, p. 853, 1915 (part); Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 482, December, 1920 (part); Whelan, Trans. Kansas Acad. Sci., 39:365, 1937; Fichter, Schildman and Sather, Ecol. Monog., 25:1, January, 1955.

Canis pallidus Merriam, Proc. Biol. Soc. Washington, 11:24, March 15, 1897 (type locality, Johnstown, Brown Co., Nebraska), not Cretzschmar, 1826.

Canis nebracensis Merriam, Science, 8(n. s.):782, December 2, 1898, a renaming of *C. pallidus;* Swenk, Proc. Nebraska Acad. Sci., 8:120, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:64, September, 1908 (part).

Canis nebrascensis [sic], Cary, Proc. Nebraska Ornith. Union, 3:65, December, 1902.

Canis nebracensis nebracensis, Swenk, Nebraska Blue Book, p. 853, 1915 (part); Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936.

Canis nebrascensis nebrascensis [sic], Swenk, Nebraska Blue Book, p. 482, December, 1920 (part).

Canis latrans latrans, Jackson, *in* Young and Jackson, The clever coyote, p. 257, November 29, 1951; Hall and Kelson, The mammals of North America, p. 844, March 31, 1959.

C[anis]. l[atrans]. latrans, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—State-wide. See Fig. 53.

Measurements.—External measurements of two males and two females from eastern Nebraska are, respectively: 1302, 1250, 1190, 1171; 368, 337, 340, 362; 219, 212, 190, 200. Five males from the eastern part of the state weighed 42¾, 36, 32½, 31½ and 30½ lbs., and two females weighed 27½ and 25⅝ lbs. A male from Thomas County has the following measurements: 1234; 346; 208; 108; weight, 30 lbs.

Cranial measurements of five males (Butler County, Cherry County (2), Sarpy County, and Thomas County, respectively) are: condylobasal length, 191.5, 194.0, 196.0, 191.0, 191.5; zygomatic breadth, 99.2, 101.8, 99.3, 105.3, 105.3; interorbital constriction, 32.7, 33.8, 33.7, 36.3, 31.1; postorbital constriction, 31.5, 35.1, 34.2, 34.4, 33.7; squamosal constriction, 61.6, 60.0, 60.9, 59.6, 60.5; alveolar length of maxillary tooth-row, 86.3, 88.4, 86.5, 85.7, 88.3. Average and extremes of corresponding measurements for 10 young adult females from Cherry County are: 177.3 (168.0-181.5); 94.3 (87.7-99.2); 30.8 (28.7-33.1); 35.2 (32.0-37.3); 57.7 (53.8-59.9); 81.7 (78.1-85.2).

Remarks.—For many years two subspecific names were applied to Nebraskan coyotes. *Canis latrans nebracensis* Merriam, with type locality at Johnstown, Brown County, Nebraska, was used for specimens from the western and central parts of the state and *C. l. latrans* (type locality, Engineer Cantonment, Washington County, Nebraska) was applied to those from the eastern part. According to Merriam (1897:24) *nebracensis* differed from *latrans* in being paler throughout, having the back of the ears buff instead of fulvous, and having a smaller skull and smaller teeth.

Jackson (1951:257) placed *nebracensis* in synonymy under *latrans* with the following comments (p. 261): "In his original description of *Canis pallidus* . . ., which form he later renamed *Canis nebracensis* . . ., Merriam compared his central Nebraska specimens with specimens from Elk River, Sherburne County, Minnesota, as representing typical *Canis latrans.* . . . As has elsewhere been pointed out . . . the coyote of the Great Lakes region, including all of Minnesota, represents another subspecies,

C. l. thamnos Jackson, and Merriam's two names *pallidus* and *nebracensis* fall as synonyms of *Canis latrans latrans*. Specimens from the type region of *Canis latrans* are indistinguishable from specimens from Johnstown, Nebraska. Say's name, therefore, applies to the coyote of the Great Plains region. The subspecies seems to be more constant in characters than most other subspecies of coyotes. Nevertheless in its peripheral range there is the usual broad band of intergradation with adjacent subspecies and subspecific determination of specimens from these borders may be difficult or a matter of personal judgment. The subspecies *latrans* can generally be recognized as the palest and grayest of the coyotes."

I tentatively follow Jackson in assigning all Nebraskan specimens to *C. l. latrans* because the material now available seems best referable to a single subspecies. I hasten to point out, however, that I have had few usable specimens from eastern Nebraska for comparisons. Skins that are available from the eastern part of the state average darker than skins from the Sand Hills and other places in western Nebraska, and agree fairly well with the description of *C. l. thamnos* and also, incidently, with the description of *C. l. latrans*, which Jackson nowhere indicates he consulted. But, no consistent cranial differences were found.

Jackson's specimens from the "type region" of *latrans* were four individuals (USNM 147356, 149722-24) from Beemer, Cuming County, a village in the Elkhorn Valley approximately 51 miles northwest of the type locality (he assigned a specimen from Missouri Valley, Iowa, only eight miles northeast of the Engineer Cantonment, but across the Missouri River, to *thamnos*). Only one of the four specimens is a skin with skull, three being skulls alone, and none is accompanied by external measurements. I agree that the four specimens from Beemer resemble topotypes of *nebracensis* but in view of the great degree of non-geographic variation in the coyote (Jackson, *op. cit.*:249-251 and elsewhere) I doubt that the four constitute in themselves conclusive evidence for submerging *nebracensis* under *latrans*. On zoogeographic and physiographic grounds coyotes from extreme eastern Nebraska would be expected to resemble individuals from the population in the upper Mississippi Valley rather than those from the Great Plains. Actually, the area may well lie in the expected broad zone of intergradation between the two populations and a large series of topotypes is needed to determine finally whether the subspecific name *latrans* is best applied to the coyote of the Great Plains or instead to the darker colored population to the east of the plains. Certainly the Missouri River

is not an absolute barrier to dispersal of the species and therefore may not be a natural boundary line between the subspecies *latrans* and *thamnos* as Jackson's map (p. 255) might imply.

Records of occurrence.—Specimens examined, 304, as follows: ADAMS COUNTY: Hastings, 1 (HM); Silverlake Twp., 1 (HM). BOX BUTTE COUNTY: 5 mi. W Alliance, 1 (UC). BROWN COUNTY: Johnstown, 28 (USNM); *Plum Creek*, 2 (AMNH); 3 mi. S Moon Lake, 5 (AMNH); *16 mi. S. Ainsworth*, 5 (AMNH); 20 mi. S Ainsworth, 1 (AMNH). BUTLER COUNTY: 4½ mi. NW David City, 2; *5 mi. E Rising City*, 2; near Dwight (dog-coyote hybrid), 1. CASS COUNTY: Louisville, 2 (NSM). CHASE COUNTY: vicinity Imperial, 56. CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge, 4-5 mi. E Valentine, 4 (2 MVZ, 1 NSM); *5 mi. SE Valentine*, 1 (MVZ); *6 mi. S Valentine*, 1 (MVZ); 7 mi. S Valentine, 1 (MVZ); *secs. 9-10, T. 32 N, R. 28 W. (approximately 8 mi. S, 2 mi. W Valentine)*, 3 (MVZ); *secs. 26-28, T. 32 N, R. 28 W (approximately 11 mi. S, 2 mi. W Valentine)*, 3 (MVZ); *sec. 34, T. 32 N, R. 28 W (approximately 12 mi. S, 2 mi. W Valentine)*, 1 (MVZ); Valentine Nat'l Wildlife Refuge, 17 (9 NSM); *Pony Lake, Valentine Nat'l Wildlife Refuge*, 4 (AMNH); Goose Creek, SE part of county, 2 (AMNH); *S of North Loup River*, 11 (AMNH); *no specific locality*, 11 (AMNH). CHEYENNE COUNTY: 15 mi. S Dalton, 4300 ft., 4. CUMING COUNTY: Beemer, 4 (USNM). DAWES COUNTY: 2½ mi. NW Chadron, 1 (AMNH); 2 mi. NE Horn, 1 (NSM). HARLAN COUNTY: 1 mi. N, 3 mi. E Oxford, 1 (NSM). HOOKER COUNTY: 16 mi. W Mullin, 3 (NSM). JEFFERSON COUNTY: Fairbury 1 (UMMZ). KEARNEY COUNTY: Ft. Kearney, 17 (1 MCZ, 16 USNM). KEYA PAHA COUNTY: *Niobrara River*, 1 (AMNH). LANCASTER COUNTY: 5 mi. N Lincoln, 1 (NSM); Denton, 2 (NSM). LINCOLN COUNTY: Sutherland, 1 (NSM); sec. 9, T. 11 N, R. 27 W (approximately 5½ mi S, 2½ mi. W Brady), 1(NSM). MORRILL COUNTY: 9½ mi SW Alliance, 1; *near Angora*, 2 (NSM); 9-10 mi. N Bridgeport, 48 (NSM); Bridgeport, 2 (NSM). PHELPS COUNTY: 10 mi. NW Holdrege, 1 (NSM). SALINE COUNTY: Crete, 2 (NSM). SARPY COUNTY: Fontanelle Forest, 1 (RV). SCOTTS BLUFF COUNTY: 5 mi. S Gering, 1 (NSM); *6 mi. S, 1 mi. E Gering*, 1 (NSM). SIOUX COUNTY: *21 mi. NW Crawford*, 1 (NSM); near Orella (1 mi. NE Harrison Ranch), 1 (NSM); *13 mi. NW Crawford*, 1 (NSM); *badlands, NW of Horn*, 1 (AMNH); 12 mi. E Harrison, 1 (NSM); *no specific locality*, 1 (AMNH). STANTON COUNTY: 7 mi. E Norfolk, 1; *6 mi. SE Norfolk*, 1. THOMAS COUNTY: 7 mi. N Thedford, 5; *Halsey*, 1 (UNDZ); *near Halsey*, 3; 4 mi. S, 2 mi. W Halsey, 1; 13½ mi. S Thedford, 19. WEBSTER COUNTY: *Bladen*, 1 (HM). WHEELER COUNTY: no specific locality, 1 (NSM). County unknown: *Platte River*, 2 (USNM).

Additional records (Gates, 1945:13, unless otherwise noted): CHERRY COUNTY: Merriman; *4-0 Ranch, south-central part.* CLAY COUNTY: no specific locality (Swenk, MS). CUMING COUNTY: West Point (Swenk, MS). DAWES COUNTY: *Crawford;* Belmont. LANCASTER COUNTY: Waverly (record on file, NGFPC); *9 mi. NW Lincoln* (Whelan, 1937:365); *Lincoln* (specimen catalogued NSM, not now to be found). PAWNEE COUNTY: no specific locality (specimen catalogued NSM, not now to be found). SCOTTS BLUFF COUNTY: *Scotts Bluff Nat'l Mon.* (Mattes, 1958:57). SHERIDAN COUNTY: Hay Springs. SHERMAN COUNTY: no specific locality (record on file, NGFPC). VALLEY COUNTY: 7 mi. S Ord (Fichter, 1950:67). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], the type locality.

Canis lupus

Gray Wolf

Judging from historical accounts *Canis lupus* was abundant in Nebraska when the white man first settled the state, especially in association with the vast herds of bison. The extirpation of the

bison destroyed the main source of food of the wolf and this, along with the widespread use of strychnine to secure pelts, resulted in a marked reduction in the wolf population. Trapping and poisoning for the protection of livestock, for fur, and for bounties of one sort or another led finally to the extirpation of the species.

The year of extinction of the wolf in Nebraska is not certainly known; probably it was between 1915 and 1920 in the northern and western parts of the state but much earlier in the southeast. The last specimen taken in Nebraska of which I have record is a mounted

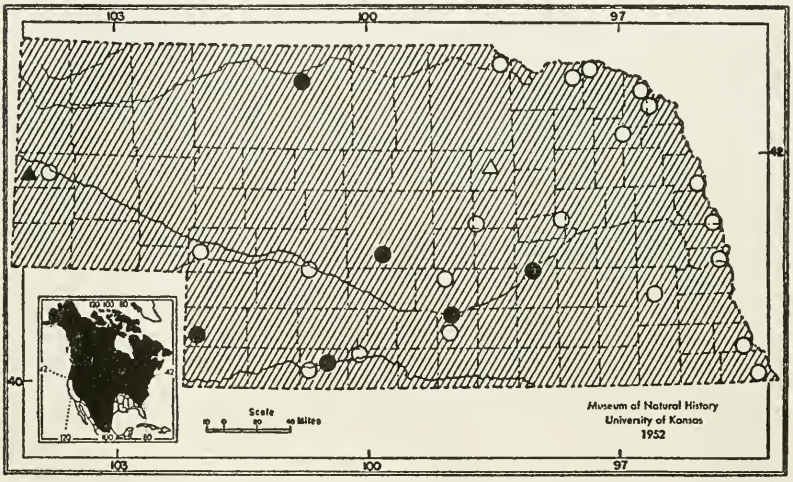

FIG. 54. Former distribution of *Canis lupus nubilus* in Nebraska. For explanation of symbols see Fig. 5.

animal at the Hastings Museum that was obtained at Oconto in 1913. A. M. Brooking reported (Swenk, MS) that a wolf was killed along the Dismal River in the same year and a newspaper article in Swenk's files gives an account of one weighing 68 pounds that was killed near Crofton in mid-December of 1915. V. Bailey (1907:11) recorded wolves as "common" in western Nebraska as late as 1889. Swenk (1908:119) wrote of the species as follows: "The Gray Wolf was formerly abundant throughout the state. . . . Of recent years, however, the packs have been disseminated, and those yet remaining in our borders are in isolated pairs or families. These . . . are becoming rarer year by year."

According to Goldman (1944:406): "Individual variation in color in most of the races of *C. lupus* is extraordinary, as it may extend through several color phases from nearly pure white to

nearly pure black." Evidently this was true of *C. l. nubilus* in Nebraska because in the historical literature seen the adjectives "gray," "dusky," "white," "black," "brown," and "yellow" were used to describe individuals. Swenk (1908:119-120 and elsewhere) even recognized two "species" in the state based upon color, the "Gray Wolf," *Canis griseus,* and the "Dusky Wolf," *Canis nubilus.* Earlier, Aughey (1880:119), evidently following Baird, had recognized the same two as "varieties."

No data pertaining to reproduction in the gray wolf in Nebraska have come to my attention although there probably are some references in the early literature. According to V. Bailey (1907:23) young are born in Wyoming in March and April; the average number of young in eight litters from that state was 7.5 (5-11).

Canis lupus nubilus Say

Canis nubilus Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:169 (footnote), 1823 (type locality, Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], Washington Co., Nebraska); Swenk, Proc. Nebraska Acad. Sci., 8:120, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:64, September, 1908 (part); Swenk, Nebraska Blue Book, p. 853, 1915 (part); Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920.

[Canis] Var. D *Lupus nubilus,* Richardson, Fauna Boreali-Americana, p. 69, 1829.

Canis occidentalis, var. *griseo-albus,* Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):104, July 14, 1858.

Canis lupus, J. A. Allen, Bull. U. S. Geol. Surv. Territories, 2(4):313, July 1, 1876; Jones, Bull. Univ. Nebraska State Mus., 4:91, November 26, 1962.

Canis occidentalis, Var. *nubilus,* Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

C[anis]. occidentalis, Var. *griseo-albus,* Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

Canis griseus, Swenk, Proc. Nebraska Acad. Sci., 8:119, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:63, September, 1908 (part).

Canis occidentalis, Swenk, Nebraska Blue Book, p. 853, 1915 (part).

Canis lupus nubilus, Goldman, The wolves of North America, p. 441, May 29, 1944; Hall and Kelson, The mammals of North America, p. 850, March 31, 1959.

C[anis]. lupus nubilus, Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 7:231, August 25, 1952.

C[anis]. l[upus]. nubilus, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—Formerly abundant throughout state; now extirpated. See Fig. 54.

Measurements.—Say (*in* James, 1823:169) recorded external measurements (in feet and inches) of a specimen of unknown sex (probably the type) from the Engineer Cantonment as: length from "tip of nose to the origin of the

tail," 1315; length of "the trunk of the tail," 330 (thus total length possibly 1645). Goldman (1944:443) recorded the total length of a male from Douglas, Wyoming, as 1982. At the latitude of Nebraska adult individuals generally weighed between 60 and 100 lbs.

Average and extreme cranial measurements (after Goldman, 1944:493) of seven males, five from Ft. Kearney and two from the Platte River, are as follows: greatest length, 251.0 (243.7-258.4); condylobasal length, 229.2 (223.8-232.3); zygomatic breadth, 136.2 (133.7-140.9); interorbital breadth, 47.6 (45.1-52.2); postorbital constriction, 37.4 (35.7-42.0); crown length of maxillary tooth-row, 105.1 (102.8-108.6). Corresponding measurements of three females (*op. cit.*:502), one from Ft. Kearney and two from the Platte River, are, respectively: 228.7, 231.0, 233.5; 210.7, 212.5, 212.9; 119.4, 130.5, 126.2; 38.9, 40.3, 37.3; 34.8, 38.0, 35.3; 99.5, 96.2, ____.

Remarks.—The subspecies *Canis lupus nubilus* probably is extinct.

Records of occurrence.—Specimens examined, 25, as follows: CHASE COUNTY: 10 mi. S Lamar, 1 (NSM). CHERRY COUNTY: sec. 5, T. 31 N, R. 30 W (approximately 5 mi. N, 7 mi. W Simeon), 1 (NSM). CUSTER COUNTY: Oconto, 1 (HM). HAMILTON COUNTY: sec. 7, T. 12 N, R. 6 W (approximately 10 mi. N, 2 mi. W Aurora), 1 (NSM). KEARNEY COUNTY: Ft. Kearney, 9 (USNM); *"Grand Isle of Platte River," Ft. Kearney,* 5 (USNM). RED WILLOW COUNTY: near Indianola, 1 (NSM). SCOTTS BLUFF COUNTY: no specific locality, 1 (NSM). County unknown: *Platte River,* 5 (USNM).

Additional records (Jones, 1962:91-92, unless otherwise noted): BOYD COUNTY: Ponca Island. BUFFALO COUNTY: along South Loup River. CEDAR COUNTY: northwestern part, along Missouri River. DAKOTA COUNTY: near mouth of Iowa [= Aowa] Creek. DIXON COUNTY: along Missouri River, about 10 mi. below mouth of Vermillion River. FURNAS COUNTY: "Republican Fork of Platte" [E of Medicine Creek; specimen obtained on October 2, 1856, by Lt. F. T. Bryan] (Baird, 1858:111). GREELEY COUNTY: southwestern part, S of North Loup River. KEARNEY COUNTY: about 10 mi. S Ft. Kearney. KEITH COUNTY: western part, between forks of Platte River. KNOX COUNTY: near Crofton (see text). LANCASTER COUNTY: Lincoln. LINCOLN COUNTY: S side Platte River, just above Brady's Island. NANCE COUNTY: vicinity Genoa. NEMAHA COUNTY: eastern part, S of Little Nemaha River. RED WILLOW COUNTY: "Republican Fork of Platte" [= E of Driftwood Creek; specimen obtained on September 30, 1856, by Lt. F. T. Bryan] (Baird, 1858:111). RICHARDSON COUNTY: ½ mi. NE Falls City. SARPY COUNTY: just above mouth of Platte River. SCOTTS BLUFF COUNTY: near Gering. THURSTON COUNTY: southeastern part, along Missouri River near Blackbird Hill. WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun], the type locality. WAYNE COUNTY: Wayne. WHEELER COUNTY: no specific locality. County unknown: *Dismal River* (see text).

Vulpes velox

Swift Fox

Little information is available concerning the former status in Nebraska of this denizen of the plains; seemingly it was fairly common in the central and western parts of the state when those areas first were settled. Swenk (1908:121) wrote of the species as follows: "The little Swift Fox is still common in central and western Nebraska, but is becoming steadily less so year by year. In the Pine Ridge country it is fairly numerous."

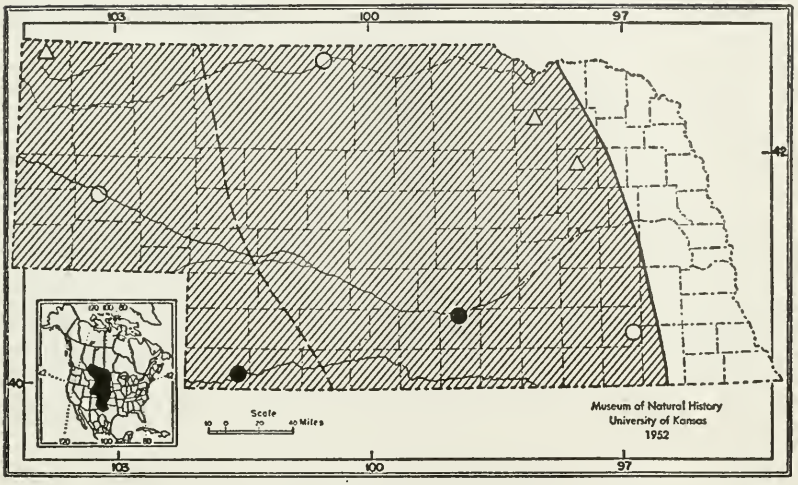

FIG. 55. Distribution of *Vulpes velox velox* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate eastern limit of present distribution.

V. velox may have been entirely extirpated in Nebraska by man in the early 1900's because between the summers of 1900-01, when Cary saw tracks in northern Sioux County (Cary, MS), and 1953 or 1954, when a female and two kits were taken near Bridgeport (C. G. Pritchard, personal communication), no record of it exists. According to V. Bailey (1927:164), writing about the species in North Dakota, individuals were "very easily trapped, poisoned, or caught by dogs, so that they did not last long after the country became settled." It is encouraging to report that the swift fox appears now to be making a come-back in at least the southern part of its former range.

Two April-taken females from the Oklahoma Panhandle each carried 4 embryos. Asdell (1946:163) recorded the number of young as 4-5.

Vulpes velox velox (Say)

Canis velox Say, *in* James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:487(footnote), 1823 (type locality, South Platte River, Colorado, possibly Logan County according to Cary, N. Amer. Fauna, 33:175, August 17, 1911).

Vulpes velox, Aububon and Bachman, The viviparous quadrupeds of North America, 2:13, 1851; Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):113, July 14, 1858; Cary, Proc. Nebraska Ornith. Union, 3:67, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:121, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:65, September, 1908.

V[ulpes]. velox, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880.

Vulpes velox velox, Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920.

V[ulpes]. v[elox]. velox, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—Formerly common in western two-thirds of state, east certainly to Madison and Saline counties; present limits of range unknown but probably confined to western third. See Fig. 55.

External measurements.—No external measurements of Nebraskan specimens are available. Average and extreme measurements of five specimens (three males, two females) from Beaver County, Oklahoma, are: 836.0 (770-880); 302.4 (265-350); 121.8 (120-125); 62.0 (60-65). The three males each weighted 5 lbs. For cranial measurements see Table 19.

Remarks.—The skull of a male (USNM 1345) from Ft. Kearney was figured by Baird (1858:pl. XXXLV).

Records of occurrence.—Specimens examined, 4, as follows: DUNDY COUNTY: eastern part along "Republican Fork" [specimen obtained on September 25, 1856, by Lt. F. T. Bryan], 1 (USNM). KEARNEY COUNTY: Ft. Kearney, 3 (USNM).

Additional records: ANTELOPE COUNTY: northern part (Cary, MS). CHERRY COUNTY: Valentine (Cary, MS). MADISON COUNTY: no specific locality (Cary, MS). MORRILL COUNTY: vicinity Bridgeport (see text). SALINE COUNTY: Wilber (specimen formerly in HM). SIOUX COUNTY: badlands of northern part (Cary, 1902:67); *Pine Ridge* (Swenk, MS).

Vulpes vulpes

Red Fox

The red fox is widely distributed and relatively common in the eastern part of Nebraska, occurs sparingly in suitable habitat in the central part of the state, and ranges westward in the Platte River Valley and adjacent areas to the Wyoming border. Present evidence, admittedly meager, suggests that much if not all of the range in the western half of the state has been only recently occupied. Probably this fox is more widely distributed in the state, and perhaps more numerous, now than at any time since the coming of white man.

The distribution in Nebraska at the time of exploration and early settlement is not especially well documented but the species evidently occurred over most if not all of the eastern part of the state. James (1823:369) listed it among the mammals found at Major Long's Engineer Cantonment in the winter of 1819-20, Stolley (1946:77) recorded it from Hall County in the 1860's, Swenk (MS) reported that specimens were taken in the vicinity of Norfolk in 1874, and the species ranged westward along the Platte at least as far as Ft. Kearney, where a specimen was taken in 1853. There is some contradiction as to the abundance in pioneer times. Aughey

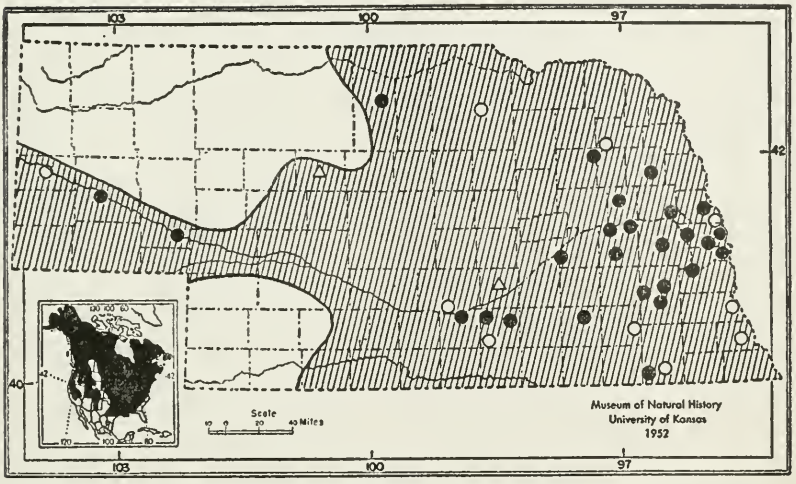

FIG. 56. Distribution of *Vulpes vulpes regalis* in Nebraska. For explanation of symbols see Fig. 5.

(1880:119) wrote as follows: "Foxes here have disappeared more completely than the wolves. Formerly the Prairie Fox (*Vulpes macrourus*) was comparatively abundant, but is now rarely seen." Cary (MS, about 1905), however, stated: "The red fox has always been rare in eastern Nebraska, and is at the present found only on the wooded bluffs along the Missouri River." Swenk (1908:121-122) even implied that the species did not occur naturally in at least parts of eastern Nebraska but that it reached the southeast, presumably from regions to the east and south of Nebraska, after 1900.

Whatever the relative abundance was of the red fox in the 19th Century the literature seemingly indicates that the species was present in at least the eastern part of the state in early times, that it became rare, at least relatively, after the coming of the white man, and that in recent decades its numbers have increased and it possibly has pushed westward beyond the limits of its original range. The disappearance of the species to which Aughey alluded probably was related to the widespread use of poison baits, especially strychnine compounds, to kill wolves and coyotes. The poisoning campaigns must have affected, seriously for a time, populations of many small carnivores, including the other species of foxes, *Vulpes velox* and *Urocyon cineroargenteus*. Only after the indiscriminate use of poison baits was curtailed did the species affected begin to regain a measure of their former status.

Two May-taken litters that were dug from dens provide the only information on reproduction available; one from Gage County contained 5 young, and the other from Butler County contained 3. The number of young per litter in the species as a whole is known to vary from 1-10.

I have followed Churcher (1959) in regarding the red foxes of the New and Old worlds as conspecific under the name *Vulpes vulpes*.

Vulpes vulpes regalis Merriam

Vulpes regalis Merriam, Proc. Washington Acad. Sci., 2:672, December 28, 1900 (type locality, Elk River, Sherburne Co., Minnesota).

[Canis] virginianus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Vulpes macrourus, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1): 130, July 14, 1858 (see p. 122); Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880.

Vulpes alopex, J. A. Allen, Bull. U. S. Geol. Surv. Territories, 2(4):318, July 1, 1876 (*Vulpes 'macrurus' [sic]* used in text).

Vulpes macrourous [sic], Swenk, Proc. Nebraska Acad. Sci., 8:122, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:66, September, 1908 (part).

Vulpes fulvus, Swenk, Proc. Nebraska Acad. Sci., 8:122, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:66, September, 1908 (part).

Vulpes fulva, Swenk, Nebraska Blue Book, p. 853, 1915 (part); Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 482, December, 1920 (part).

Vulpes macrurus [sic], Swenk, Nebraska Blue Book, p. 853, 1915 (part); Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 482, December, 1920 (part).

V[ulpes]. f[ulva]. regalis, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957 (one of three subspecies listed as possibly occurring in Nebraska; *V. f. fulva* and *V. f. macroura* listed also).

Distribution in Nebraska.—Eastern part of state, west certainly to Brown and Thomas counties, and west in Platte Valley to Wyoming border. See Fig. 56.

External measurements.—Respective measurements of three males and two females from southeastern Nebraska are: 1024, 965, 945, 946, ___; 381, 298, 370, 349, 368; ___, 152, 160, 149, 156; 76, ___, 85, 73, 82. The female last-listed weighed 10½ lbs. For cranial measurements see Table 19.

Remarks.—All Nebraskan specimens of this species are assigned tentatively to *V. v. regalis,* the subspecies of the northern plains, although some specimens from the southeastern part of the state are smaller cranially than North Dakotan and Minnesotan specimens of *regalis* and approach *V. v. fulva.* Even so, most specimens from south of the Platte are distinctly larger than specimens of *fulva* examined from the eastern United States. Judging from the few

skins available Nebraskan specimens average darker, more reddish, and have more black on the legs than usual in specimens of *regalis* (certainly darker than the holotype of that subspecies) and I interpret the darker color, along with the smaller size of some specimens, as indicative of intergradation between *regalis* and *fulva.* Cockrum (1952:233) assigned red foxes from eastern Kansas to *fulva.*

Swenk (1908:121-122 and elsewhere) referred Nebraskan foxes to two different subspecies, *fulva* and *macroura,* which at that time he regarded as full species. The inclusion of *macroura* in the Nebraskan fauna apparently dates back to Baird (1858:122), who listed a specimen from Ft. Kearney under that name many years prior to the original description of *regalis.* The specimen from Ft. Kearney (USNM 1325), figured by Baird (*op. cit.*:pl. XXXIII), and all others from the western Platte Valley are clearly referable to *regalis* rather than *macroura,* the long-tailed subspecies of the Rocky Mountains and adjacent areas.

The red fox may be found to occur in extreme northwestern Nebraska. A specimen (KU 85502) tentatively assigned to *V. v. regalis* was taken in 1960 on the southern edge of the Black Hills, 10 mi. N Rumford, Fall River County, South Dakota, only about 18 miles north of the Sioux County line.

Records of occurrence.—Specimens examined, 43, as follows: ADAMS COUNTY: 1 mi. W Cottonwood Ranch, Kenesaw, 1 (HM); Hastings, 1 (HM); *near Hastings,* 1. BROWN COUNTY: 1 mi. NW Ainsworth, 1 (AMNH). BUTLER COUNTY: 12 mi. NE David City, 1; Bellwood, 1; 4 mi. E Rising City, 3. CASS COUNTY: South Bend, 1 (NSM). COLFAX COUNTY: 12 mi. N, 3 mi. W Schuyler, 2. CUMING COUNTY: West Point, 1 (RV). DODGE COUNTY: Fremont, 2 (RV). DOUGLAS COUNTY: Florence, 2 (RV); Valley, 1 (RV); *Millard,* 1 (RV); Ralston, 1 (RV). FILLMORE COUNTY: 1 mi. E Fairmont, 1. GAGE COUNTY: 6½ mi. NW Odell, 6 (NSM). GARDEN COUNTY: 5 mi. W Lewellen, 1. KEARNEY COUNTY: Ft. Kearney, 1 (USNM). LANCASTER COUNTY: 7 mi. NE Lincoln, 1 (UNDZ); 1 mi. S Emerald, 1; 3 mi. S State Penitentiary, Lincoln, 1 (UC). MADISON COUNTY: Elkhorn River, 1 mi. E Norfolk, 2. MORRILL COUNTY: Bridgeport, 1 (NSM). POLK COUNTY: 5 mi. N, 2 mi. W Polk, 1. SARPY COUNTY: Bellvue, 2 (1 HM, 1 RV); *3 mi. S Papillion,* 1. SAUNDERS COUNTY: Wahoo, 1 (RV). WASHINGTON COUNTY: Blair, 3 (RV).

Additional records (Swenk, MS, unless otherwise noted): ADAMS COUNTY: Logan Twp. BUFFALO COUNTY: near Kearney. DOUGLAS COUNTY: *Omaha* (Swenk, 1908:122). GAGE COUNTY: near Blue Springs (Swenk, 1908:122). HALL COUNTY: no specific locality (Stolley, 1946:77). HOLT COUNTY: 4 mi. E O'Neill (recent newspaper account). LANCASTER COUNTY: *Salt Creek, Lincoln* (Swenk, 1908:122). NEMAHA COUNTY: near Auburn. OTOE COUNTY: along Missouri River, N of Nebraska City. SALINE COUNTY: N of Wilbur. SCOTTS BLUFF COUNTY: Scotts Bluff Nat'l Mon. (Mattes, 1958:57). THOMAS COUNTY: no specific locality (Smith, 1958:62). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369). WAYNE COUNTY: near Hoskins. Fichter's (1944:18) map that records red foxes taken in the 1942 trapping season has been taken into account in preparing Fig. 56.

Urocyon cinereoargenteus

Gray Fox

Little is revealed in the literature concerning the relative abundance of the gray fox in Nebraska in historical times although there is no question that the species occurred in at least the eastern part of the state. James (1823:169) recorded it as found at the Engineer Cantonment in the winter of 1819-20, Stolley (1946:77) mentioned the species as occurring in Hall County in the 1860's, Aughey (1880:119) reported specimens taken in Pierce County in 1869, and Velich (1961:93) listed a specimen taken in 1894 in Washington County.

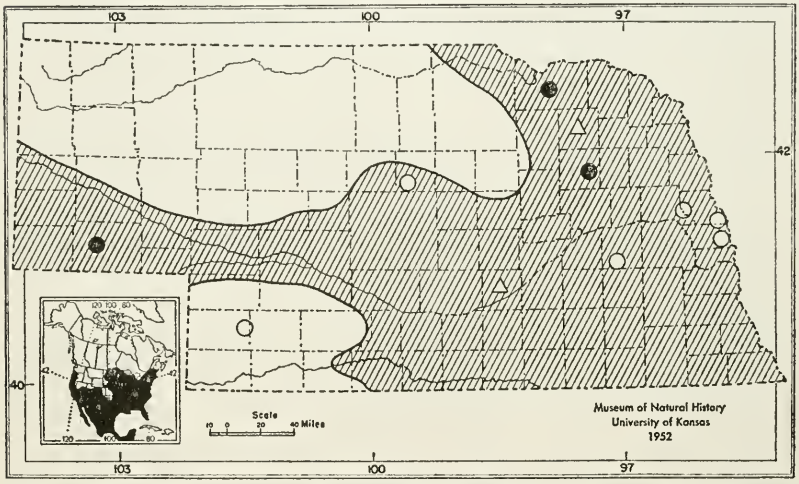

FIG. 57. Distribution of *Urocyon cinereoargenteus ocythous* in Nebraska. For explanation of symbols see Fig. 5.

As in the case of the two species of *Vulpes*, populations of the gray fox probably were drastically reduced by the widespread, indiscriminate use of poison baits in the late 1800's and early 1900's to control the wolf and coyote. In any event, although a few unconfirmed reports of the presence of the species were received in the first half of the 20th Century, no certain record of its occurrence in the state after 1894 was forthcoming until 1953 when three individuals were taken, one in Omaha (Velich, 1958:148), another near Ulysses (A. V. Hascall, personal communication), and the third in the vicinity of Enola. Reports of occurrence, some verified by actual specimens, have become increasingly frequent since 1953

and *U. cinereoargenteus* seems now to be well established, although not so common as the red fox, in the eastern part of Nebraska and evidently in the Platte River drainage nearly to the western border of the state. Similar increases in numbers of the gray fox in recent years have been reported for Iowa (Polder, 1958:560-562) and Kansas (Anderson and Nelson, 1958:308-309). According to Polder (*loc. cit.*) the species frequents "weedy flood plains and brushy timber bordering streams" in northwestern Iowa.

I have no evidence to suggest whether the current population of this fox in Nebraska results from increase and dispersal of native stock, from invasion from areas to the eastward, or from both, but it is doubtful that the species ever was entirely extirpated in Nebraska.

Females bear young from late March to May at the latitude of Nebraska; litters comprise 2-7 offspring according to Asdell (1946: 162).

Urocyon cinereoargenteus ocythous Bangs

Urocyon cinereoargenteus ocythous Bangs, Proc. New England Zool. Club, 1:43, June 5, 1899 (type locality, Platteville, Grant Co., Wisconsin); Polder, Proc. Iowa Acad. Sci., 65:560, November 20, 1958; Hall and Kelson, The mammals of North America, p. 863, March 31, 1959.

[Canis] cinereo-argenteus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

V[ulpes]. Virginianus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880.

Urocyon cinereo-argenteus ocythous, Swenk, Proc. Nebraska Acad. Sci., 8:123, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:67, September, 1908; Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919.

Urocyon cireneo argenteus [sic] ocythous, Swenk, Nebraska Blue Book, p. 482, December, 1920.

U[rocyon]. c[inereoargenteus]. ocythous, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957; Velich, Jour. Mamm., 39:148, February 20, 1958.

Urocyon cinereoargenteus, Velich, Jour. Mamm., 42:93, February 20, 1961.

Distribution in Nebraska.—Eastern third of state and west in Platte River drainage to Panhandle; also reported from archeological site in Chase County. See Fig. 57.

External measurements.—No measurements of Nebraskan-taken individuals are available. Findley (1956*a*:1) recorded the following measurements of a male from Jerauld County, South Dakota: 964; 343; 140; 75. Two females from Douglas County, Kansas, measured: 975, 980; 350, 330; 135, 143; 62, 82. The weight of the first-listed female was 10½ lbs. For cranial measurements see Table 19.

Remarks.—A single specimen from the Sioux Ordinance Depot, Cheyenne County (KU 83467), a skull only of unknown sex (probably male, judging from its large size), is clearly referable to *U. c. ocythous* rather than to the smaller *U. c. scottii,* which was reported

from Loveland, Colorado, in the foothills of the Rocky Mountains approximately 125 miles southwestward, by Cary (1911:176). The skull from Cheyenne County was obtained in June of 1960 from a recently killed animal and signals the probable occurrence of *ocythous* in adjacent parts of Colorado and Wyoming.

Recent records of *U. c. ocythous* from western South Dakota indicate that the species may be found in the Niobrara Valley and adjacent areas of northern Nebraska where it is not now known to occur.

TABLE 19.—CRANIAL MEASUREMENTS OF THREE SPECIES OF FOXES.

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Postorbital constriction	Palatal length	Length of nasals	Length of maxillary tooth-row
Vulpes velox velox, Ft. Kearney, Kearney County							
1345 USNM, ♂	113.1	62.4	23.3	23.3	59.5	42.5	53.6
1343 USNM, ♀	109.5	63.4	23.9	21.7	56.6	40.2	52.9
1347 USNM, ♀	108.6	60.4	23.4	23.9	56.2	39.1	51.9
Republican Fork, Dundy County							
2613 USNM, ?	105.8	62.2	24.8	24.0	54.5	38.8	49.9
Vulpes vulpes regalis, eastern Nebraska							
Average 8 (♂)	139.3	75.6	26.8	22.7	71.9	55.8	63.8
Minimum	133.8	73.7	25.3	21.0	68.0	50.7	61.5
Maximum	146.0	77.5	28.8	24.2	76.4	59.1	66.9
Average 10 (♀)	132.9	71.2	25.5	22.5[9]	68.0	53.0	60.5
Minimum	128.2	67.8	24.1	20.4	64.2	49.5	57.6
Maximum	137.1	74.3	27.2	24.4	70.9	56.8	63.3
Ft. Kearney, Kearney County							
1325 USNM, ♀	142.1	71.6	25.3	22.0	71.8	54.2	65.0
5 mi. E Lewellen, Garden County							
84909 KU, ♂	137.0	76.4	31.5	24.2	71.9	58.0	64.1
Urocyon cinereoargenteus ocythous, Knox County							
287701 USNM, ♂	120.5	69.3	24.9	28.4	59.5	43.4	52.4
287702 USNM, ♂	123.3	70.5	26.3	29.3	.....	44.1	52.0
Sioux Ordinance Depot, Cheyenne County							
83467 KU, ?	123.3	71.0	27.4	31.4	60.4	49.6	50.7

Records of occurrence.—Specimens examined, 4, as follows: CHEYENNE COUNTY: NW corner Sioux Ordinance Depot, 1. KNOX COUNTY: Center, 1 (USNM); S *of Center*, 1 (USNM). MADISON COUNTY: 1½ mi. N, 1½ mi. W Enola, 1 (NGFPC).

Additional records: BUTLER COUNTY: near Ulysses (see text). CHASE COUNTY: 12 mi. N Wauneta (Hill and Metcalf, 1942:204, archeological site). DOUGLAS COUNTY: Omaha (Velich, 1958:148); *Otis Park, near Omaha* (Swenk, MS). HALL COUNTY: no specific locality (Stolley, 1946:77). LOUP COUNTY: Almeria (Velich, 1961:93). PIERCE COUNTY: no specific locality (Aughey, 1880:119). WASHINGTON COUNTY: N of Fremont (R. Velich, personal communication); Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369); *near Ft. Calhoun* (Velich, 1961:93).

Family URSIDAE—Bears

KEY TO NEBRASKAN URSIDS

1. Usually pale brownish; front claws more than 50, longer than hind claws; m1 having one cusplet or more medially in concavity between metaconid and entoconid; M2 broadest anteriorly ..... *Ursus horribilis*, p. 263

1'. Usually blackish or cinnamon; front claws less than 50, about equal in length to hind claws; m1 lacking cusplets in concavity between metaconid and entoconid; M2 broadest approximately midway along its length ..... *Ursus americanus*, p. 261

Ursus americanus

Black Bear

Historical accounts indicate that the black bear occurred in eastern Nebraska and westward along the Niobrara and Loup rivers at least to Cherry County. No records are available to indicate that it occurred also in the western part of the state but it is difficult to believe that the species did not range westward along all the larger rivers and into the Pine Ridge area as well. Probably *U. americanus* was more or less limited to wooded areas.

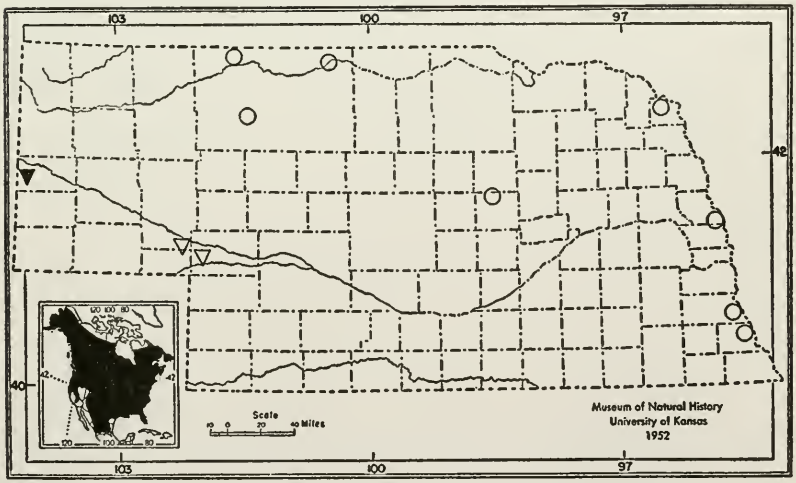

FIG. 58. Records of occurrence of two species of bears in Nebraska. *Ursus americanus americanus* (circles). *Ursus horribilis horribilis* (inverted triangles). Inset map shows distribution of *U. americanus* in North America.

Judging from the available information the species was uncommon in Nebraska except possibly along the Missouri River in the southeast. Most of the records in the literature are from along the Missouri. Lewis and Clark recorded (Thwaites, 1905:122): "*The Black Bear* is found in abundance [along the Missouri] as high as the little Sieoux *[sic]* river . . . [it is] found much higher but scarce *[sic]*." J. J. Audubon, however, saw only one bear in his trip up the Missouri in 1843 and remarked as follows (Audubon and Coues, 1898:490): "In talking to our captain [of the river steamer Omega] he tells us that the Black Bear is rarely seen swimming this river, and that one or two of them are about all he observes on going up each trip."

The most recent record of the black bear in Nebraska is Swenk's (1908:124) report of an individual killed near Valentine in the winter of 1907. There have been persistent reports that a few black bears have invaded the Pine Ridge in recent years but these remain to be verified. Given adequate protection I suspect that a small number of bears could exist on the Pine Ridge.

Ursus americanus americanus Pallas

Ursus americanus Pallas, . . . Spicilegia zoologica . . ., fasc. 14:5, 1780 (type locality, eastern North America); Swenk, Proc. Nebraska Acad. Sci., 8:124, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:68, September, 1908; Jones, Bull. Univ. Nebraska State Mus., 4:92, November 26, 1962.

Ursus Americanus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823; Aughey, Sketches of the physical geography and geology of Nebraska, p. 118, 1880.

Ursus americanus americanus, Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920.

U[rsus]. a[mericanus]. americanus, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—Formerly eastern part of state, west certainly to Cherry County; probably also in wooded areas of western part of state; now extirpated. See Fig. 58.

Measurements.—No Nebraska-taken specimens are known. V. Bailey (1927:191) recorded the external measurements of an adult male from Montana as: 1680; 105; 275. According to Burt (1948:121) the length of skull varies from 257-291 and the zygomatic breadth from 150-176.

Records of occurrence.—Specimens examined, none.

Additional records (Jones, 1962:92-93, unless otherwise noted): CHERRY COUNTY: Bear Creek (Swenk, 1908:124); near Valentine (Swenk, 1908:124); between North Loup River and Bush Lake (101° 28′ W, 42° 23′ N). DAKOTA COUNTY: northern part, along Missouri River. GREELEY COUNTY: 40 mi. N Loup River on Cedar River (location not certainly placed in Greeley County). NEMAHA COUNTY: Sun Island, Missouri River, between Peru and Brownville. OTOE COUNTY: "Missouri bottom" (Swenk, 1908:123). WASHINGTON COUNTY: *Rockport* (Swenk, 1908:124); Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369). County unknown: *Niobrara River* (Swenk, 1908:123).

Ursus horribilis

Grizzly Bear

The former distribution of the grizzly bear in Nebraska is not well documented. Probably the species occurred uncommonly on the High Plains of the Panhandle and eastward some distance in the hills and breaks along the Platte and Niobrara rivers. Only one actual specimen, a skull picked up in the 1930's at Roubadeau Pass, Scotts Bluff County, is known.

I have found only three citations to the grizzly bear in the historical literature of Nebraska (Jones, 1962:93): Edwin James noted in a general discussion of the species that a hunter had seen a "bear," presumably a grizzly, on the "Qui Court [Niobrara] river," but gave no specific locality; J. H. Carlton saw tracks along Ash Creek, Garden County, in 1845; and R. B. Marcy encountered a female with two cubs on the "elevated table-lands lying between the two forks of the Platte River," probably in western Keith County, in 1858. Marcy (1863:172-173) gave an account of the killing of the adult.

The paucity of records of the species in literature dealing with the early exploration of Nebraska and the complete absence of records from the archeological sites thus far reported upon corroborate the contention that the grizzly bear was comparatively rare in the state. G. M. Allen's (1942:144) statement that it was found in some numbers in Nebraska was based upon the specimens from "Nebraska" listed by Baird (1858:225), all of which actually originated from some other western state.

Ursus horribilis horribilis Ord

Ursus horribilis Ord, *in* Guthrie, A new geographical, historical, and commercial grammer . . ., ed. 2, 2:291, 299, 1815 (type locality, north side of Missouri River, near mouth of Wolf Creek, Roosevelt Co., Montana); Jones, Bull. Univ. Nebraska State Mus., 4:93, November 26, 1962.

Ursus horribilis horribilis, Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920.

U[rsus]. h[orribilis]. horribilis, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—Formerly rare on High Plains of western part of state; eastern limits of distribution not certainly known; probably east along Platte and Niobrara rivers to about the 100th meridian; now extirpated. See Fig. 58.

Measurements.—No external measurements of a specimen from Nebraska are available. Some cranial measurements of an individual of unknown sex from Scotts Bluff County are as follows: greatest length of skull, 371; condylobasal length, 330; zygomatic breadth, 195.

Remarks.—The type locality of *U. h. horribilis* has been located at different places in northeastern Montana by different authors.

The specimen on which Ord based the description of *Ursus horribilis* was obtained by members of the Lewis and Clark Expedition on May 5, 1805, on the north side of the Missouri River near the mouth of Wolf Creek in what is now Roosevelt County, Montana (see discussion in Coues, 1893:292-301).

Some recent authors (Couturier, 1954:329; Erdbrink, 1953:339; Rausch, 1953:105, and others) have regarded the brown bears of the Palearctic and Nearctic regions as conspecific and therefore employed the name *Ursus arctos horribilis* for the grizzly bear.

Records of occurrence.—Specimen examined, 1, as follows: SCOTTS BLUFF COUNTY: Roubadeau Pass, SW of Scotts Bluff Nat'l Mon., 1 (Scotts Bluff Nat'l Mon. Collection).

Additional records: See text above.

Family PROCYONIDAE—Raccoons and Allies

Procyon lotor

Raccoon

The raccoon is state-wide in distribution in suitable habitat—woodlands, usually where water is present, and around lakes and marshes. It is perhaps the most abundant of Nebraskan carnivores and one of the most important economically. The pelt has remained of sufficient value that many still are marketed each year; the meat is eaten by man and is said to be in greater demand than that of any other mammal normally classed as a fur-bearer; and the hunting of raccoons is a popular sport, especially in the southeastern part of the state, where it provides recreational and economic benefit to many residents. Corn is one of the staple foods and high concentrations of individuals result, on occasion, in significant loss to farmers. Raccoons are inactive in the coldest parts of the winter; in fact, Sharp and Sharp (1956:170-177), who studied behavior of the species on the Valentine National Wildlife Refuge, reported that adults could forecast approaching storms.

The paucity of accounts that mention the raccoon in the literature dealing with the early settlement of Nebraska suggests that it was less common then than now. Unquestionably the conversion to agriculture of the river valleys and adjacent areas in the western part of the state has provided food and shelter for substantial populations of raccoons where few or no individuals occurred previously. Around the marshes of the Sand Hills, where few trees grow, individuals find refuge primarily in burrows in the ground.

I have no record of the introduction of raccoons into Nebraska from other states but it is possible that some introductions have

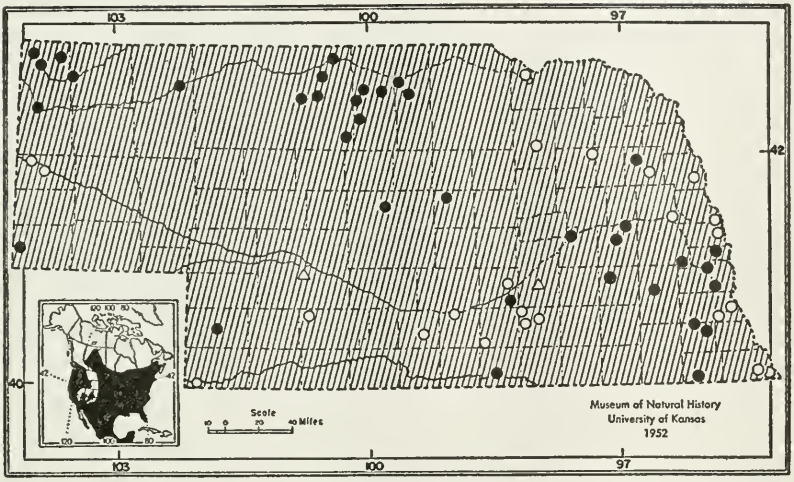

FIG. 59. Distribution of *Procyon lotor hirtus* in Nebraska. For explanation of symbols see Fig. 5.

been made. Stains (1956:27) reported that approximately 2000 raccoons were brought from other places and liberated in Kansas between 1939 and 1956.

Females bear young only once annually—usually in late spring. Stains (*loc. cit.*:30) reported an average of 4.6 (3-7) young for eight litters from Kansas. A female taken on July 17, 1957, in Sheridan County was lactating; no other data on reproduction are available from Nebraska.

Procyon lotor hirtus Nelson and Goldman

Procyon lotor hirtus Nelson and Goldman, Jour. Mamm., 11:455, November 11, 1930 (type locality, Elk River, Sherburne Co., Minnesota); Goldman, N. Amer. Fauna, 60:37, November 7, 1950.

Procyon lotor, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823; Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):209, July 14, 1858; Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:708, 1859; Hayden, Trans. Amer. Philos. Soc., 12(n. s.):143, 1863; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 92, 1875; J. A. Allen, Bull. U. S. Geol. Surv. Territories, 2(4):325, July 1, 1876; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:124, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:68, September, 1908; Sharp and Sharp, Jour. Mamm., 37:170, June 9, 1956.

Procyon loter [sic], Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

P[rocyon]. Hernandezzii [sic], Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

Procyon lotor lotor, Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:27, October, 1936.

P[roycon]. l[otor]. hirtus, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 59.

Measurements.—External measurements of three males and three females from southeastern Nebraska are, respectively: 908, 908, 889, 825, 832, 871; 248, 324, 273, 254, 270, 251; 121, 122, 114, 117, 105, 112; 60 (one female). Corresponding respective measurements of four males and three females from northwestern Nebraska are: 881, 842, 914, 838, 808, 795, 838; 293, 258, 254, 254, 246, 254, 228; 125, 130, 140, 127, 110, 116, 127; 69, 67, 64, —, 59, 64, 63. The weights of two males and two females (all summer-taken) from the last-mentioned series were, respectively, 15¼, 14½, 12, and 12½ lbs.; a winter-taken male and female weighed 16¼ and 22½ lbs., respectively.

Cranial measurements of two males and a female from Butler County, followed by those of a male and female from Sioux County, are, respectively: condylobasal length, 119.1, ——, 110.5, 119.8, 113.6; zygomatic breadth, 84.0, 83.0, 75.5, 83.2, 72.9; interorbital constriction, 25.9, 24.9, 24.6, 27.4, 22.3; postorbital constriction, 24.6, 22.7, 24.7, 24.8, 20.9; mastoid breadth, 66.8, 68.7, 59.7, 64.1, 61.6; alveolar length of maxillary tooth-row, 45.5, 45.0, 42.3, 44.1, 42.2.

Records of occurrence.—Specimens examined, 103, as follows: BROWN COUNTY: Plum Creek, N of Johnstown, 10 (AMNH); *Plum Creek,* 19 (AMNH); *[Long] Pine Creek,* 1 (AMNH); Bone Creek, 10 (AMNH); *Cedar Creek,* 1 (AMNH); *Johnstown,* 1 (USNM); 6 mi. SW Johnstown, 3 (AMNH); Kirkpatrick Marsh (approximately 15 mi. S, 3 mi. W Johnstown), 4 (AMNH). BUTLER COUNTY: *Platte River,* 1; 11 mi. NE David City, 1; *9 mi. NE David City,* 1; near David City, 8. CASS COUNTY: Louisville, 1 (NSM); 35 mi. E Lincoln, 1 (UC). CHASE COUNTY: 1 mi. N, 6.4 mi. W Imperial, 3300 ft., 1. CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge, 4 (3 NSM, 1 USNM); Schlegel Creek, 1 (NSM); Valentine Nat'l Wildlife Refuge, 8 (3 NSM); near Kennedy, 2; *Beaver Lake,* 2 (NSM); *Rat Lake,* 1 (NSM); Goose Creek, 3 (AMNH). CUMING COUNTY: Beemer, 2 (USNM). CUSTER COUNTY: Victoria Springs, 1 (UMMZ). DAWES COUNTY: 4 mi. SW Crawford, 2 (NSM). HALL COUNTY: Doniphan, 1 (HM). JOHNSON COUNTY: 1 mi. S, ¾ mi. E Burr, 1; 10 mi. E Sterling, 1 (NSM). KEYA PAHA COUNTY: *Niobrara River,* 6 (AMNH). KIMBALL COUNTY: Smeed, 1. LANCASTER COUNTY: Lincoln, 2 (1 NSM, 1 UC). MERRICK COUNTY: Silver Creek, 1 (RV). PAWNEE COUNTY: 4 mi. S, 8 mi. W Pawnee City, 1. ROCK COUNTY: Short Pine Creek, 3 (AMNH); head of Elkhorn River, 1 (AMNH). SARPY COUNTY: Papillion, 1 (RV). SAUNDERS COUNTY: Ashland, 1 (NSM). SEWARD COUNTY: Staplehurst, 3 (NSM). SIOUX COUNTY: Squaw Canyon, 1 (WSC); "Toadstool Park" (SW of Orella), 1 (NSM); Sowbelly Canyon, 1 (NGFPC); *6½-7 mi. W Crawford,* 4 (2 NSM); Agate, 3 (RV). SHERIDAN COUNTY: 11 mi. S Gordon, 1. VALLEY COUNTY: 7 mi. NW Ord, 1 (NGFPC). WEBSTER COUNTY: Red Cloud, 2 (NSM). County unknown: *"Nebraska,"* 1 (USNM); *vicinity Republican River between Red Cloud and Superior,* 1 (NSM).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). ANTELOPE COUNTY: Neligh (Cary, MS). BURT COUNTY: Tekamah (Swenk, MS). CLAY COUNTY (Swenk, MS): Trumbull; Harvard; Inland. CUMING COUNTY: West Point (Cary, MS). DODGE COUNTY: Fremont (specimen catalogued in NSM, not now to be found). DOUGLAS COUNTY: Omaha (Cary, MS). DUNDY COUNTY: Haigler (Goldman, 1950:38). FRONTIER COUNTY: Maywood (Swenk, MS). HALL COUNTY: Grand Island (specimen formerly in HM). HAMILTON COUNTY: no specific locality (specimen formerly in HM). KEARNEY COUNTY: Ft. Kearney (Baird, 1858:212). KNOX COUNTY: near mouth of Niobrara River (Hayden, 1859:708). LINCOLN COUNTY: no specific locality (Swenk, MS). MADISON COUNTY: Norfolk (Cary, MS). OTOE COUNTY:

Nebraska City (Cary, MS); 2 mi. N Talmage (specimen catalogued in NSM, not now to be found). PHELPS COUNTY: Holdrege (Swenk, MS). RICHARDSON COUNTY: Falls City (Cary, MS); 4 mi. SE Rulo (Hill and Wedell, 1936:63, archeological site). SCOTTS BLUFF COUNTY: 2 mi. W Mitchell (specimen catalogued in NSM, not now to be found); Scotts Bluff Nat'l Mon. (Mattes, 1958:57). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369). County unknown: *"Ft. Riley to Ft. Kearney"* (Baird, 1858:212).

Family MUSTELIDAE—Weasels, Skunks and Allies

KEY TO NEBRASKAN MUSTELIDS

1. Toes webbed; 36 teeth (premolars 4/3).....*Lutra canadensis*, p. 296
1′. Toes not webbed or only slightly so; 34 or 38 teeth (premolars 3/3 or 4/4).....2
2(1′). Upper parts black and white; bony palate extending posteriorly beyond M1 less than length of that tooth.....3
2′. Upper parts brownish, yellowish, or grayish over-all; bony palate extending posteriorly beyond M1 more than length of that tooth.....4
3(2). Upper parts having two white stripes; zygomatic breadth more than 40; maxillary tooth-row more than 20.....*Mephitis mephitis*, p. 291
3′. Upper parts having four or more broken white lines (or spots); zygomatic breadth less than 40; maxillary tooth-row less than 20. *Spilogale putorius*, p. 288
4(2′). Weight more than 5 pounds; tail only slightly longer than hind foot; condylobasal length more than 80.....5
4′. Weight less than 5 pounds; tail more than twice length of hind foot (except in *Mustela nivalis*); condylobasal length less than 80.....6
5(4). Upper parts brownish; 38 teeth (premolars 4/4).....*Gulo luscus*, p. 282
5′. Upper parts yellowish gray to silvery gray; 34 teeth (premolars 3/3). *Taxidea taxus*, p. 284
6(4′). Total length more than 500; condylobasal length more than 55.....7
6′. Total length less than 500; condylobasal length less than 55.....8
7(6). Upper parts dark brownish; interorbital breadth less than 17 in males and less than 16 in females.....*Mustela vison*, p. 279
7′. Upper parts yellowish brown; prominent black mask on face; interorbital breadth more than 17 in males and more than 16 in females. *Mustela nigripes*, p. 273
8(6′). Total length less than 300; tail not tipped with black; maxillary tooth-row less than 12.....*Mustela nivalis*, p. 276
8′. Total length more than 300; tail tipped prominently with black; maxillary tooth-row more than 12.....*Mustela frenata*, p. 267

Mustela frenata

Long-tailed Weasel

This species is distributed generally over the state but is nowhere especially common. Among the mustelids still extant in Nebraska it appears to be less numerous than the mink, striped skunk, and badger, perhaps about equal in numbers to the least weasel and spotted skunk, and more abundant than the black-footed ferret. A rough measure of its relative abundance is provided by the furbearers reported as taken in Nebraska in the 1959-60 season (Wildlife Leaflet 436, U. S. Fish and Wildlife Service, June, 1961). A

total of 139 long-tailed weasels were obtained in that period in comparison with the following numbers of other small carnivores: raccoon, 12,906; mink, 8,458; skunk (both species), 2,999; badger, 513.

M. frenata molts to a white pelage in winter in northern Nebraska as evidenced by specimens examined from Cedar, Cuming,

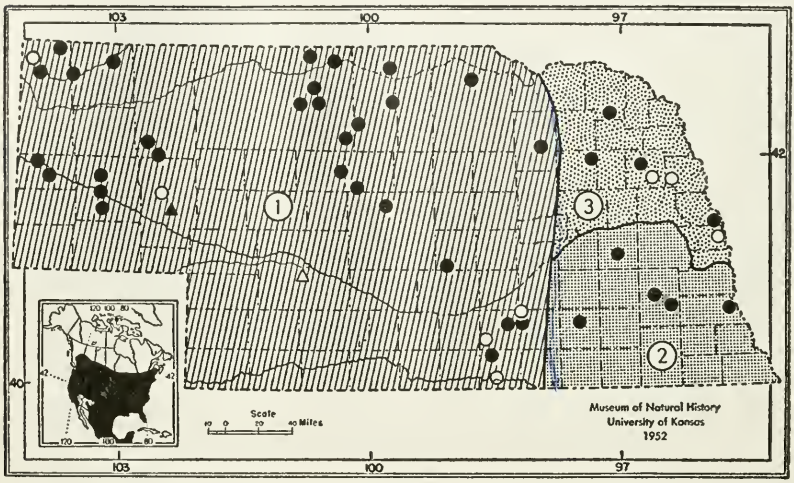

FIG. 60. Distribution of *Mustela frenata* in Nebraska. 1. *M. f. longicauda.* 2. *M. f. primulina.* 3. *M. f. spadix.* For explanation of symbols see Fig. 5.

and Washington counties. South of the Platte River, however, the winter pelage is brown, longer and paler than that of summer, as seen in individuals from Adams, Clay, Fillmore, and Otoe counties.

According to Hall (1951:217) females bear a single litter annually (in spring) that contains up to 9 young.

Mustela frenata longicauda Bonaparte

Mustela longicauda Bonaparte, Charlesworth's Mag. Nat. Hist., 2:38, 1838 (type locality, "possibly Carlton House, Saskatchewan," according to Hall and Kelson, The mammals of North America, p. 912, March 31, 1959).

Mustela frenata longicauda, Hall, Publ. Carnegie Inst. Washington, 473: 105, November 20, 1936; Hall, Univ. Kansas Publ., Mus. Nat. Hist., 4:262, December 27, 1951 (part); Hall and Kelson, The mammals of North America, p. 912, March 31, 1959 (part).

P[utorius]. longicauda, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880.

Putorius longicaudus, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:130, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:74, September, 1908.

Mustela longicauda longicauda, Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib.

Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936.

Mustela l[ongicauda]. longicauda, Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Mustela frenata alleni, Hall, Univ. Kansas Publ., Mus. Nat. Hist., 4:274, December 27, 1951 (part); Miller and Kellogg, Bull. U. S. Nat. Mus., 205:739, March 3, 1955 (part); Hall and Kelson, The mammals of North America, p. 911, March 31, 1959 (part).

M[ustela]. f[renata]. alleni, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957 (part).

M[ustela]. f[renata]. longicauda, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957 (part).

Distribution in Nebraska.—Western three-fourths of state, east certainly to Adams, Antelope, and Clay counties. See Fig. 60.

External measurements.—Average and extreme measurements of 10 males, followed by those of five adult and young adult females, from western Nebraska are: 427.1 (400-459), 362.2 (343-375); 155.0 (138-175), 127.2 (115-142); 47.5 (42-54), 42.6 (39-47); 23.6[5] (19-26), 17.6 and 18 (two only). Two of the males weighed 275.0 and 315.5 grams. For cranial measurements see Table 20.

Remarks.—From *Mustela frenata spadix* and *Mustela frenata primulina,* both geographically adjacent to the east in Nebraska, *M. f. longicauda* differs in being distinctly paler dorsally (clay color rather than dark brown) in summer pelage. It differs additionally from *primulina* in being larger, in having the color of the venter extending onto the hind feet, and in having the least width of color of the underparts more than 40 per cent of the greatest width of color of the upper parts. It differs additionally from *spadix* (Hall, 1951:263) by having in males a deeper occiput in which the depth of the skull, exclusive of the sagittal crest, amounts to more than 59 per cent of the mastoid breadth.

Specimens assigned herein to *longicauda* from the eastern edge of its range in Nebraska are intergrades with one or the other (or both) of the two subspecies, *M. f. primulina* and *M. f. spadix,* that occur in the eastern part of the state. A female from Neligh, for example, is assigned to *longicauda* owing to its relative paleness but resembles *primulina* most in size. Hall (*op. cit.*:266-267) discussed reasons for assignment to *longicauda* of intergrades from Adams and Clay counties. Examination of the specimens mentioned by him as well as additional specimens from these two counties, in which I find a rather wide range of individual variation in both size and color, underscores the difficulty of identifying them to subspecies. To my way of thinking weasels from Adams and Clay counties could be assigned with about equal propriety either to *primulina* or to *longicauda;* I follow Hall in listing them under the latter name.

Mustela frenata alleni (type locality, Custer, Custer County, South Dakota) was recorded from Nebraska by Hall (*op. cit.*:276) on the basis of four specimens from Mitchell, which he regarded as intergrades between *alleni* and *longicauda*. *M. f. alleni* (otherwise known only from the Black Hills of South Dakota and Wyoming) combines the pale coloration of *longicauda* with the small size of *M. f. nevadensis*, a subspecies occupying a large geographic range in the intermountain region to the west of Nebraska. The four individuals from Mitchell are indeed smaller than typical *longicauda* but resemble it in color and their original assignment to *alleni* is understandable. However, specimens accumulated from northwestern Nebraska since the publication of Hall's revision are not so small as the four from Mitchell and are referable to *longicauda*. For example, a male from 2½ mi. W Gering, but a few miles southeast of Mitchell, is larger (434; 155; 45; 24) than the average of specimens I have examined and a young male from 3 mi. W Crawford, on the Pine Ridge roughly equi-distant between Mitchell and the Black Hills, clearly is assignable to *longicauda*, although smaller (417; 146; 46; 24) than average for the subspecies. Other specimens from northwestern counties (Sioux, Morrill, Dawes, and Sheridan) also approach *longicauda* to a greater degree than *alleni* and Hall himself (p. 269) assigned two individuals from Ft. Laramie, Wyoming, in the Platte Valley to the west of Mitchell, to the former.

It thus appears that the specimens from Mitchell, surrounded as they are by localities from which have originated weasels assignable to *longicauda*, are best placed with that subspecies. Their relative smallness, and that of certain other specimens examined from the northwestern part of the state, undoubtedly indicates intergradation with *alleni* or *nevadensis* or both.

Records of occurrence.—Specimens examined, 68, as follows: ADAMS COUNTY: Hastings, 5 (2 AMNH, 3 HM); *6 mi. S Hastings*, 1 (HM); *no specific locality*, 2 (HM). ANTELOPE COUNTY: Neligh, 1 (NSM). BLAINE COUNTY: 3 mi. SE Dunning, 1 (NGFPC). BROWN COUNTY: Long Pine, 1 (Stanford Univ.); Long Lake, 1 (AMNH). CHERRY COUNTY: W of Crookston, 1 (NSM); 5 mi. E Valentine, 1(NGFPC); near Simeon, 1 (NSM); *Valentine Nat'l Wildlife Refuge*, 4 (NSM); *Hackberry Lake, Valentine Nat'l Wildlife Refuge*, 1 (UMMZ); Kennedy, 1 (USNM); 11 mi. E Kennedy, 1; Goose Creek, 1 (AMNH); *Sand Hill region*, 1 (NSM); *S part of county*, 1 (NSM); *no specific locality*, 1 (USNM). CLAY COUNTY: Inland, 9 (4 HM, 5 NSM). CUSTER COUNTY: Victoria Springs, 1 (UMMZ). DAWES COUNTY: Chadron, 2 (NSM); 3 mi. W Crawford, 1 (NSM). GARDEN COUNTY: no specific locality, 1. HOLT COUNTY: Eagle Creek, 1. KEYA PAHA COUNTY: Springview, 2 (CSTC). MORRILL COUNTY: 11 mi. N Bridgeport, 2 (NSM); *3 mi. S junction of hgys. 19 [=385] and 26*, 1 (NSM); Bridgeport, 3 (NSM); Greenwood Canyon, 9 mi. S Bridgeport, 2 (NSM). SCOTTS BLUFF COUNTY: Mitchell, 4 (NSM); 2½ mi. W Gering, 1 (NSM). SHERIDAN COUNTY: 4 mi. N Antioch, 1

(UMMZ); 19 mi. E, 2 mi. S Alliance, 1; *no specific locality,* 1 (NGFPC). SHERMAN COUNTY: 1 mi. NW Sweetwater, 1 (NGFPC). SIOUX COUNTY: 21 mi. NW Crawford, 1 (NSM); *badlands, 18 mi. NW Crawford,* 1 (NSM); near Harrison, 1 (NSM); *3½ mi. N Glen,* 1 (NSM); *Bald Butte* (not exactly located), 2 (AMNH). THOMAS COUNTY: near Halsey, 1. WEBSTER COUNTY: Bladen, 1 (HM).

Additional records (Swenk, MS, unless otherwise noted): ADAMS COUNTY: Logan Twp. CHERRY COUNTY: *Ft. Niobrara Nat'l Wildlife Refuge* (Beed, 1936:21). CLAY COUNTY: Trumbull. GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272). LINCOLN COUNTY: no specific locality. SIOUX COUNTY: Warbonnet Canyon (Cary, MS). WEBSTER COUNTY: Red Cloud.

Mustela frenata primulina Jackson

Mustela primulina Jackson, Proc. Biol. Soc. Washington, 26:123, May 21, 1913 (type locality, 5 mi. NE Avilla, Jasper Co., Missouri).

Mustela frenata primulina, Hall, Publ. Carnegie Inst. Washington, 473:104, November 20, 1936.

Distribution in Nebraska.—Southeastern part of state south of Platte River. See Fig. 60.

External measurements.—Measurements of two males from Fillmore County, a male from Lancaster County, a male from Butler County, and an individual of unknown sex (probably a male) from Lancaster County are, respectively: 413, 376, 382, 400, 362; 131, 121, 131, 132, 132; 48, 45, 43, 42, 43; 22, 24, 19, —, —. The smallest of the two males from Fillmore County weighed 293.7 grams. For cranial measurements see Table 20.

No females are presently available from Nebraska. Hall (1951:233) recorded the average and extreme measurements of six adult and subadult females from Douglas County, Kansas, as follows: 339 (317-355); 107 (95-115); 35 (34-37).

Remarks.—From *Mustela frenata spadix,* geographically adjacent to the north in Nebraska, *M. f. primulina* typically differs as follows (Hall, *loc. cit.*): "least width of color of under parts amounting to less than 40 per cent of greatest width of color of upper parts, by absence of color of underparts on hind leg below knee, and by smaller size." Another possible difference between these two subspecies, perhaps fortuitous, is that the line marking the place where white winter pelage (as opposed to brown winter pelage) is acquired parallels roughly the presently understood boundary between them. For comparison with *Mustela frenata longicauda,* geographically adjacent to the west in the state, see account of that subspecies.

The presence of *M. f. primulina* in southeastern Nebraska has been expected (Jones, 1957:280) but the specimens herein reported are the first from the state to be assigned definitely to that subspecies.

Specimens examined from Adams and Clay counties are intergrades between *primulina* and *M. f. longicauda.* The reasons for assigning them to *longicauda* are given in the account of that subspecies.

Records of occurrence.—Specimens examined, 6, as follows: BUTLER COUNTY: Garrison, 1 (UNDZ). FILLMORE COUNTY: 1 mi. S Fairmont, 1; *2 mi. N Geneva,* 1. LANCASTER COUNTY: Lincoln, 1 (NGFPC); 3 mi. N, 2 mi. W Bennet, 1. OTOE COUNTY: Nebraska City, 1 (RV).

Mustela frenata spadix (Bangs)

Putorius longicauda spadix Bangs, Proc. Biol. Soc. Washington, 10:8, February 25, 1896 (type locality, Fort Snelling, Hennepin Co., Minnesota).

Mustela frenata spadix, Hall, Publ. Carnegie Inst. Washington, 473:105, November 20, 1936; Hall, Univ. Kansas Publ., Mus. Nat. Hist., 4:252, December 27, 1951; Hall and Kelson, The mammals of North America, p. 914, March 31, 1959.

?*Putorius noveboracensis,* Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

?*P[utorius]. cigognanii [sic],* Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

M[ustela]. f[renata]. spadix, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957.

Distribution in Nebraska.—Presently known from north of Platte River in northeastern part of state. See Fig. 60.

External measurements.—Measurements of males from Cedar, Cuming, and Madison counties and a subadult female from Cuming County are, respectively: 370, 425, 372, 375; 130, 160, 120, 113; 44, 50, 50, 44; 21, —, 17, —. For cranial measurements see Table 20.

Remarks.—For comparison with *Mustela frenata longicauda* and *Mustela frenata primulina,* both geographically adjacent to *M. f. spadix* in Nebraska, see accounts of those subspecies. I follow Hall (1951:261) in assigning weasels from northeastern Nebraska to *M. f. spadix.* Specimens presently available from there actually are intergrades between *spadix* and *M. f. primulina,* and possibly also with *M. f. longicauda.* Hall (*loc. cit.*) discussed his reasons for assigning five specimens from Beemer to *spadix.* In addition to these five, males examined from Norfolk, Ft. Calhoun, and near Belden are assigned herein to that subspecies.

The male from Norfolk, a skin only, has small external measurements, which are typical of *M. f. primulina* except that the hind foot (50 mm.) is large and intermediate between those of *primulina* and *spadix.* The color pattern resembles typical *spadix* in that the dorsum is dark brown, the least width of color of the underparts amounts to more than 41 per cent of greatest width of color of the upper parts, and the color of the underparts extends onto the hind feet. The specimen from near Belden, taken on November 17, 1958, is in white winter pelage. Its external measurements are typical of *primulina* but Belden is north of the other localities from which *spadix* is here recorded and this specimen is assigned to that subspecies on geographic grounds. Findley (1956*b*:24) identified two specimens from Clay County, South Dakota, just north across

the Missouri River from Cedar County, with *M. f. spadix,* but indicated the possibility of their being "three way intergrades" between *spadix, longicauda,* and *primulina.* The specimen from Ft. Calhoun, a mounted animal in white winter pelage that lacks external measurements, also is assigned to *spadix* on geographic grounds, as are the additional records listed beyond.

More specimens from eastern Nebraska are needed before the subspecific identity of weasels occurring there can be determined accurately. In a general way, individuals presently available from the northeastern part of the state combine the coloration of *spadix* with the external size of *primulina* and have crania that are nearer *spadix* than *primulina* in dimensions. A female from Neligh, herein assigned to *M. f. longicauda* because of its paleness, is slightly darker dorsally than typical specimens of *longicauda* (thus approaching *spadix* and *primulina*) and resembles *primulina* in size.

Records of occurrence.—Specimens examined, 8, as follows: Cedar County: near Belden, 1 (NSM). Cuming County: Beemer, 5 (USNM). Madison County: Norfolk, 1 (NSM). Washington County: Ft. Calhoun, 1 (RV).

Additional records: Burt County: Oakland (Swenk, MS). Cuming County: West Point (Swenk, MS). Douglas County: Omaha (Cary, MS).

Mustela nigripes

Black-footed Ferret

The black-footed ferret is among the rarest of North American mammals. In Nebraska the range of the species, both present and former, corresponds closely to that of the black-tailed prairie dog *(Cynomys ludovicianus);* in fact, the distribution of *M. nigripes* in general coincides with that of prairie dogs, which apparently serve as its principle source of food and whose burrows it inhabits. Destruction by man of many thousands of prairie dog towns on the Great Plains has undoubtedly affected adversely population levels of the ferret and yet the species seems to be holding its own fairly well. As Cahalane (1954:423) pointed out, *M. nigripes* obviously can and does prey upon small mammals other than prairie dogs. One correspondent reported to him *(loc. cit.)* that numbers of ferrets seemed not to have decreased markedly in South Dakota in periods when prairie dogs were nearly annihilated over broad areas of that state.

The prairie dog still is widely distributed in western and central Nebraska and conditions therefore presently favor the survival of *M. nigripes.* Recorded occurrences in the state over the last four

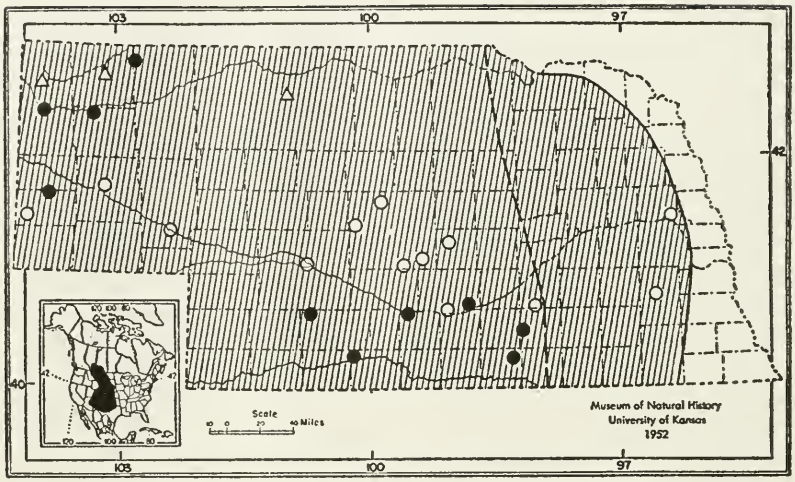

FIG. 61. Distribution of *Mustela nigripes* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate eastern limit of present distribution.

decades do not indicate a reduction in the population of ferrets. Four occurrences were recorded in the 1920's, four in the 1930's, two in the 1940's, and ten in the 1950's. The most recent report that I know of is from E. W. Eustace (personal communication) of Lebanon, Kansas, who saw three or four black-footed ferrets northeast of Bridgeport in the autumn of 1959. The animals, possibly a family group, had opened several pocket gopher burrows. Cahalane (*loc. cit.*:422) reported the species most "numerous" in the region "from central and western Nebraska to the southwestern corner of North Dakota."

Fichter and Jones (1953:387) commented on the relative abundance of *M. nigripes* on the Loess Plains of south-central Nebraska as opposed to other major land types in the western part of the state and on the absence of records from the Sand Hills. Subsequent information shows the species to be widely distributed on the High Plains but has revealed little concerning the Sand Hills, although Cary's (MS) report of the species from the "Snake River region" of Cherry County does provide evidence of occurrence there. A specimen from "near Anselmo" (Velich, 1961:93) is from the border between the Sand Hills and the Loess Plains. As suggested by Fichter and Jones, the greater activity of man on the cultivated Loess Plains in comparison to the grazing lands of the Sand Hills and High Plains probably has made for "more frequent contact

between ferrets and humans and thereby a greater take of specimens." Nevertheless, the paucity of records from the Sand Hills seems to indicate that the species is rarer there than in areas to the north, west, and south of the Sand Hills.

Little is known concerning reproduction in this species. Cahalane (1954:420) recorded 4 young found in a nest in South Dakota. Birth of young evidently is in spring; Aldous (1940:23) captured a young female in New Mexico on July 10, 1929, and two young ferrets were killed by a cat in South Dakota in June, 1952 (Cahalane, *loc. cit.*). A subadult female (measurements: 428; 115; 47) was taken on May 6, 1946, 9 mi. S Gering, Nebraska.

Mustela nigripes (Audubon and Bachman)

Putorius nigripes Audubon and Bachman, The viviparous quadrupeds of North America, 2:297, 1851 (type locality, Ft. Laramie, Goshen Co., Wyoming, according to Hayden, Trans. Amer. Philos. Soc., 12(n. s.):138, 1863); Swenk, Proc. Nebraska Acad. Sci., 8:130, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:74, September, 1908.

Mustela nigripes, Miller, Bull. U. S. Nat. Mus., 79:102, December 31, 1912; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Fichter and Jones, Jour. Mamm., 34:385, August 14, 1953; Cahalane, Jour. Mamm., 35:418, August 20, 1954; Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957; Hall and Kelson, The mammals of North America, p. 914, March 31, 1959; Velich, Jour. Mamm., 42:93, February 20, 1961.

Putorius (Cynomyanax) nigripes, Coues, Misc. Publ. U. S. Geol. Surv. Territories, 8:149, 1877.

P[utorius]. nigripas [sic], Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880.

Distribution in Nebraska.—Formerly western three-fourths of state, east certainly to Dodge and Lancaster counties; presently confined to western two-thirds of state. See Fig. 61.

External measurements.—Measurements of a male from Rosemont, followed by those of a male from S of Overton, are: 522, 572; 130, 140; 68, 63; —, 32. A male from Hermosa, South Dakota, measured: 533; 127; 63; —. For cranial measurements see Table 20.

Records of occurrence.—Specimens examined, 12, as follows: BANNER COUNTY: 9 mi. S Gering, 1 (NSM). BOX BUTTE COUNTY: 5 mi. SE Marsland, 1 (NSM). BUFFALO COUNTY: [near] Gibbon, 2 (HM). CLAY COUNTY: Glenvil, 1 (HM). FRONTIER COUNTY: [near] Maywood, 1 (HM). FURNAS COUNTY: [near] Cambridge, 1 (HM). PHELPS COUNTY: S of [Platte] River bridge, Overton, 1 (NGFPC). SHERIDAN COUNTY: Spotted Tail Indian Agency (approximately 11 mi. N, 2 mi. W Hay Springs), 1 (USNM). SIOUX COUNTY: Agate, 1 (AMNH). WEBSTER COUNTY: [2 mi. S] Rosemont, 1 (AMNH). County unknown: *"N. Platte, Neb.,"* 1 (USNM)—probably taken along North Platte River in present-day Nebraska or Wyoming.

Additional records (Fichter and Jones, 1953:385-387, unless otherwise noted): BANNER COUNTY: SW of Harrisburg (Cahalane, 1954:419). BUFFALO COUNTY: Kearney. CHERRY COUNTY: "Snake River region" (Cary, MS). CUSTER COUNTY: near Anselmo (Velich, 1961:93); Arnold; 10 mi. S Ansley (Cahalane, 1954:419); 20 mi. S Broken Bow (Cahalane, 1954:419). DAWES

COUNTY: *Marsland; no specific locality* (Cahalane, 1954:419). DODGE COUNTY: Fremont. FRONTIER COUNTY: *Curtis*. GARDEN COUNTY: Oshkosh. HAMILTON COUNTY: N of Harvard. LANCASTER COUNTY: Lincoln. LINCOLN COUNTY: North Platte. MORRILL COUNTY: N of Bridgeport (see text). SHERMAN COUNTY: Loup City (record on file, NSM). SIOUX COUNTY: no specific locality (Cahalane, 1954:419).

The ferret reported to have been taken near Grand Island, Hall County, by Fichter and Jones (1953:387), based on information available at that time, actually was obtained near Anselmo, Custer County, according to Ralph Velich (correspondence, November 7, 1959, and 1961:93).

Mustela nivalis

Least Weasel

The least weasel, a circumboreal species, reaches the southern limit of its North American distribution in Nebraska save for a narrow zone extending southward in the Appalachian Mountains to North Carolina. Excepting from Clay County (where a "colony" was reported by Swenk, 1926) and the adjoining part of Adams County, from 4½ mi. NW Springview (where two individuals were collected on February 8, 1959), and from the vicinity of Schuyler (see text below), *M. nivalis* is known only by a single specimen from each locality of record. This situation has led to the impression among some naturalists that the species is rare in most of its range in the state. Possibly it is rare, but I suspect this dimunitive weasel oftentimes escapes detection owing to its small size and secretive habits; it is likely also that some are mistaken for young of *Mustela frenata* or otherwise misidentified. Several specimens have been found in recent years in the pellets of raptorial birds.

As might be expected, detection of one individual from an area may lead to the subsequent discovery of others. This was the case in connection with the concentration reported from Clay County (from which area incidently a number of individuals have been taken subsequently) and it was also the case in the vicinity of Schuyler in the winter of 1950-51. Edward Hashberger trapped an immature female at Schuyler on November 25, 1950, and sent it in the flesh to the Nebraska Game, Forestation and Parks Commission for identification. I replied, providing identification and requesting additional information on the species in that area. Alerted, Hashberger obtained evidence of at least three more individuals as set forth in his interesting letter dated February 9, 1951: "In reply to your inquiry concerning [the] least weasel, this is the first year I have encountered them and I have trapped about 57 years. The first one was taken in a number 1 Victor trap; it was evidently caught upright as it was instantly killed. The second one was met

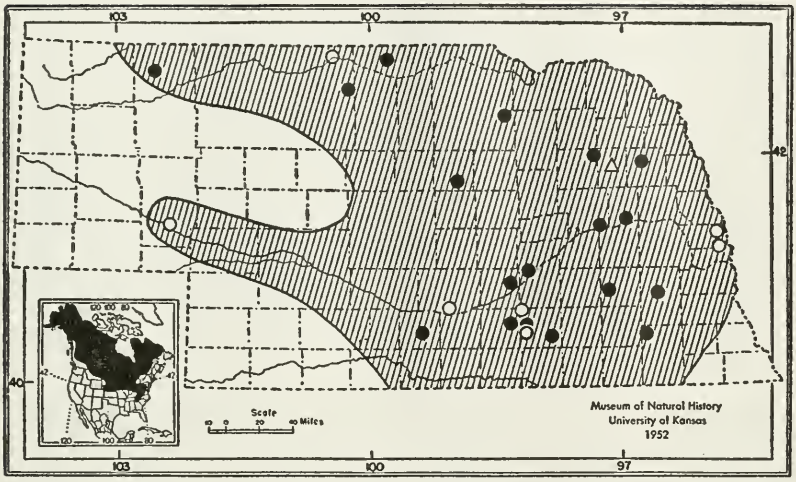

FIG. 62. Distribution of *Mustela nivalis campestris* in Nebraska. For explanation of symbols see Fig. 5.

while crossing a small piece of farm land lying between Shell and Lost Creeks, about 4½ miles east of Schuyler. When it saw me coming it stood erect and squeaked, and was ready for a fight. I was wearing rubber boots and placed my foot on it. The reason I didn't think it a weasel was that it made no attempt to run but wanted to fight. Near where the first one was taken another was seen, and after the last snow I saw tracks near where I got the second one."

Mustela nivalis evidently molts to a white pelage in winter throughout its range in North America excepting in the southern part of the range of the subspecies *M. m. allegheniensis* (Hall, 1951:170). Winter-taken skins from Nebraska (Adams County, January 2, 1957; Holt County, February 1, 1918; Phelps County, December 20, 1958) all are entirely white. March-taken specimens from Clay and Merrick counties are molting from winter to summer pelage.

A litter of 4 young was found at Trumbull on July 1, 1917 (Swenk, 1926:321). According to Hall (*op cit.*:178) young may be born in any month of the year; seven litters recorded by him contained an average of 5.0 (3-10) offspring.

Mustela nivalis campestris Jackson

Mustela campestris Jackson, Proc. Biol. Soc. Washington, 26:124, May 21, 1913 (type locality, Beemer, Cuming Co., Nebraska); Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:24, October, 1936.

Mustela nivalis campestris, Hall and Kelson, The mammals of North America, p. 1082 (addenda), March 31, 1959.

P[utorius]. pusillus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880.

Putorius rixosus, Swenk, Proc. Nebraska Acad. Sci., 8:131, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:75, September, 1908.

Mustela rixosa campestris, Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 411, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 483, December, 1920; Swenk, Jour. Mamm., 7:329, November 23, 1926; Hall, Univ. Kansas Publ., Mus. Nat. Hist., 4:190, December 27, 1951; Jones, Univ. Kansas Publ., Mus. Nat. Hist., 7:486, April 21, 1954; Velich, Jour. Mamm., 37:272, June 9, 1956; Velich, Jour. Mamm., 39:147, February 20, 1958; Hall and Kelson, The mammals of North America, p. 908 (text), March 31, 1959.

M[ustela]. r[ixosa]. campestris, Jones, Trans. Kansas Acad. Sci., 60:279, October 22, 1957.

Distribution in Nebraska.—Eastern part of state, excepting possibly extreme southeast, west certainly to Sheridan County in northern part and to Garden County in Platte Valley. See Fig. 62.

External measurements.—Average and extreme measurements of three males, followed by those of 10 females, all from south-central Nebraska are: 224.3 (211-237), 200.6 (184-225); 36.7 (32-39), 31.5 (25-40); 26.7 (24-28), 21.3 (16-26); 14, 12, 11.5, 11 (two specimens each sex). A female from ¼ mi. W Grand Island weighed 39.5 grams. For cranial measurements see Table 20.

Remarks.—Reichstein (1958) studied cranial variation in the least weasel (*M. rixosa*) and the mouse weasel (*M. nivalis*) in Europe, concluded that the two were conspecific, and thus arranged *rixosa* as a synonym of the earlier-named *nivalis*. I follow Reichstein (p. 169) in applying the specific name *nivalis* to the North American least weasel. Additional evidence of the close relationship of New World and Old World representatives is provided by the baculum. Comparison of the baculum of a specimen of *M. n. mosanensis* (USNM 299205) from Korea with that of an individual of *M. n. campestris* (KU 83726) from Clay County shows the two to be strikingly similar and to differ only in slight detail.

On March 14, 1959, a small weasel, of which the skull alone was saved, was captured 4½ mi. N and 5 mi. W Rushville, between the then known ranges of *M. n. campestris* and the equally small *Mustela erminea muricus*, known from as near Nebraska as the Black Hills. The collector did not record whether or not the tip of the tail was black, but direct comparison of the skull with specimens of *M. n. campestris* and with specimens of *M. e. muricus* from Wyoming reveals without doubt that it is assignable to the former. This record is the westernmost for the subspecies and reduces the distance between the known ranges of *M. n. campestris* and *M. e. muricus* (½ mi. E Sylvan Lake, South Dakota—Hall, 1951:165) to approximately 94 miles.

M. nivalis never has been reported from Kansas but the proximity to that state of Nebraskan records suggests that the species occurs at least along the northern border, especially in the area between the Republican and Blue rivers.

Records of occurrence.—Specimens examined, 35, as follows: ADAMS COUNTY: Hastings, 3 (HM); *no specific locality,* 1 (HM). CHERRY COUNTY: Wood Lake, 1 (CNHM). CLAY COUNTY: Inland to 1 mi. E thereof, 14 (7 HM, 7 NSM); sec. 29, T. 6 N, R. 5 W (approximately 4 mi. N, 4 mi. E Ong), 1. COLFAX COUNTY: Schuyler, 1 (NGFPC). CUMING COUNTY: Beemer, 1 (USNM). GAGE COUNTY: Clatonia, 1 (RV). HALL COUNTY: ¼ mi. W Grand Island, 1 (NGFPC). HOLT COUNTY: Page, 1 (NSM). KEYA PAHA COUNTY: 4½ mi. NW Springview, 2 (CSTC). LANCASTER COUNTY: Lincoln, 1 (NGFPC). MADISON COUNTY: Norfolk, 1 (NSM). MERRICK COUNTY: Chapman, 1 (NSM). PHELPS COUNTY: 1¾ mi. N, 3 mi. W Holdrege, 1 (NSM). PLATTE COUNTY: Columbus, 1 (RV). SEWARD COUNTY: Goener, 1 (NSM). SHERIDAN COUNTY: 4½ mi. N, 5 mi. W Rushville, 1 (NGFPC). VALLEY COUNTY: 10 mi. S Ord, 1 (NGFPC).

Additional records: BUFFALO COUNTY: Kearney (Swenk, MS). CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge (Beed, 1936:24). CLAY COUNTY: (Swenk, 1926:321): Trumbull; Glenvil. COLFAX COUNTY: *4½ mi. E Schuyler* (see text). DOUGLAS COUNTY: Florence (Swenk, MS); near Ralston (Velich, 1958:147). GARDEN COUNTY: Oshkosh (Swenk, 1926:321). ROCK COUNTY: *Newport* (Karl Menzel, personal communication). STANTON COUNTY: no specific locality (William J. Bailey, personal communication).

Mustela vison

Mink

The mink is evidently the most abundant of the four species of the genus *Mustela* that occur in Nebraska. It is common along water courses throughout the state but probably is commonest in the lake regions of the Sand Hills where several thousand are

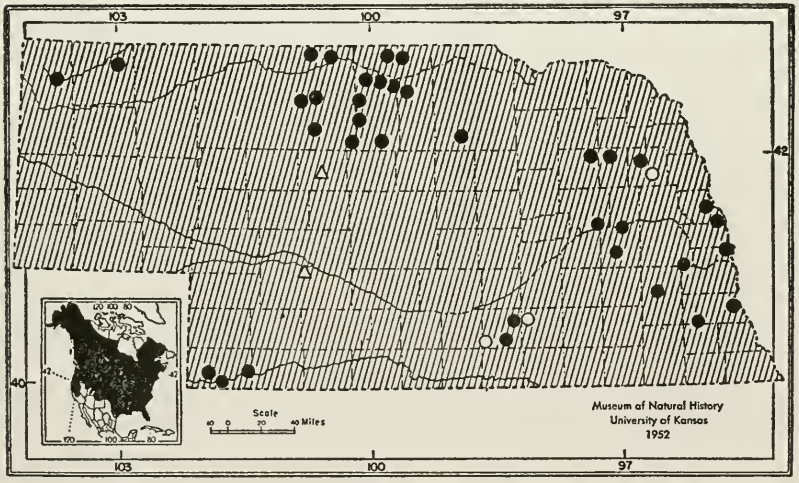

FIG. 63. Distribution of *Mustela vison letifera* in Nebraska. For explanation of symbols see Fig. 5.

trapped annually. The pelt is presently more valuable than that of any other Nebraskan fur-bearer and *M. vison* now (1962) may account for more gross income than any other species.

Females bear a single litter annually in late spring that according to Burt (1948:141) contains 3-10 young.

Mustela vison letifera Hollister

Mustela vison letifera Hollister, Proc. U. S. Nat. Mus., 44:475, April 18, 1913 (type locality, Elk River, Sherburne Co., Minnesota); Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 483, December, 1920 (part).

Mustela minx [sic], James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823 (part).

[Mustela] vison, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823 (part).

P[utorius]. vison, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

P[utorius]. nigrescens, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

Putorius vison lutreocephalus, Swenk, Proc. Nebraska Acad. Sci., 8:130, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:74, September, 1908.

Mustela vison energumenos, Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 483, December, 1920 (part); Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:27, October, 1936.

M[ustela]. v[ison]. letifera, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957.

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 63.

External measurements.—Average and extreme measurements of seven males from Nebraska are: 630.7 (594-686); 200.3 (185-217); 71.0^5 (68-76); 26.3^3 (25-27); weights recorded for three of the seven males were 3 lbs., 2¼ lbs., and 1145 grams. Two females from Cherry County measured: 559, 560; 203, 185; 64, 62. For cranial measurements see Table 20.

Remarks.—Swenk (1918:410 and in later checklists) recorded both *M. v. letifera* ("Common along water courses over most of the state") and *M. v. energumenos* ("Common northwestwardly") from Nebraska; subsequently Beed (1936:27) employed the name *energumenos* for mink from Ft. Niobrara National Wildlife Refuge in an ecological study of that area. I suspect that the use of *energumenos* by these two authors was predicated entirely on geographic considerations for examination of specimens of *M. vison* presently available from Nebraska indicates no basis for their assignment to more than the one subspecies, *M. v. letifera.*

TABLE 20.—CRANIAL MEASUREMENTS OF FOUR SPECIES OF MUSTELA.

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Postorbital constriction	Mastoid breadth	Length of maxillary tooth-row
Mustela frenata longicauda, Cherry County						
73467 KU, ♂	50.1	28.2	10.7	8.9	26.1	14.6
12614 NSM, ♂	49.3	.....	10.7	9.7	24.7	14.5
25407 USNM, ♂	51.4	29.8	12.0	8.9	26.4	15.2
Inland, Clay County						
4095 NSM, ♂	49.7	28.2	10.4	8.5	24.6	15.0
4093 NSM, ♀	45.6	24.5	9.6	7.8	22.6	13.7
Northwestern Nebraska						
Average 4 (♂)	49.2	28.8	11.3	10.1	25.1	14.9
Minimum	48.2	27.4	10.4	9.8	23.9	14.6
Maximum	50.2	30.2	12.1	10.3	26.1	15.1
4089 NSM, ♀	45.4	24.9	10.4	8.5	23.2	13.6
4091 NSM, ♀	44.5	24.6	9.4	8.4	22.7	13.4
NGFPC, ♀	46.9	25.3	9.8	8.8	22.9	14.1
Mustela frenata primulina, Otoe County						
RV, ♂	50.6	29.4	10.7	8.3	26.2	15.3
Mustela frenata spadix, Cuming County						
147375 USNM, ♂	53.2	27.8	10.6	8.8	26.4	15.8
147432 USNM, ♂	51.9	26.3	10.7	9.0	25.4	15.5
148721 USNM, ♀	51.0	27.7	10.7	9.7	25.3	15.0
Mustela nigripes, Rosemont, Webster County						
121610 AMNH, ♂	69.6	42.1	17.9	13.2	38.0	20.7
Mustela nivalis campestris, Clay County						
83726 KU, ♂	33.8	18.4	7.8	7.0	16.5	9.3
4079 NSM, ♂	.....	18.0	7.5	7.3	16.1	10.0
4082 NSM, ♂	33.7	17.8	7.0	6.2	16.0	9.1
4076 NSM, ♀	31.1	15.4	5.8	6.1	15.7	8.4
4078 NSM, ♀	34.1	15.9	6.9	7.4	15.3	9.2
Mustela vison letifera, Cherry County						
12617 NSM, ♂	70.3	40.5	15.8	12.0	37.1	22.7
12618 NSM, ♂	71.7	39.2	16.3	14.5	36.5	20.9
12619 NSM, ♀	63.4	33.8	14.4	13.6	30.0	20.2
12587 NSM, ♀	63.2	36.0	14.3	13.2	31.7	19.1
Sioux County						
12225 NSM, ♂	66.7	40.3	15.7	14.0	34.7	20.5
76835 KU, ♀	60.1	35.0	12.9	12.3	30.2	18.1

Records of occurrence.—Specimens examined, 375, as follows: ADAMS COUNTY: Hastings, 2 (HM); Ayr, 1 (NSM). BROWN COUNTY: Plum Creek, 25 (AMNH); Sand Creek, 4 (AMNH); *Bone Creek,* 21 (AMNH); [Long] Pine Creek, 2 (AMNH); *Cedar Creek,* 1 (AMNH); *Johnstown,* 9 (USNM); Brush Creek, 5 (AMNH); Kirkpatrick Marsh (approximately 15 mi. S, 3 mi. W Johnstown), 29 (AMNH); *Twin Lakes* (*secs. 9 and 16, T. 27 N, R. 24 W*), 3 (AMNH); *Wales Marsh* (*sec. 13, T. 27 N, R. 24 W*), 12 (AMNH); *Long Lake,* 2 (AMNH); *Calamus River,* 66 (AMNH); 25 mi. S Ainsworth, 1 (AMNH); *Steel's Lake* (not found), 2 (AMNH). BUTLER COUNTY: Platte River, 1; 4 mi. E Rising City, 1. CHERRY COUNTY: W of Crookston, 2 (NSM); Ft. Niobrara Nat'l Wildlife Refuge, 1 (NSM); *Valentine,* 1 (UNDZ); *Niobrara River,* 1 (NSM); *sec. 27, T. 33 N, R. 28 W, 6 mi. SE Valentine,* 1 (MVZ); Valentine Nat'l Wildlife Refuge, 23 (20 NSM); near Kennedy, 3; *Rat Lake,* 1 (NSM); Nor.n Loup River, Brownlee, 45 (AMNH); Goose Creek, 15 (AMNH); *no specific locality,* 1. CUMING COUNTY: Beemer, 13 (USNM). DAWES COUNTY: Chadron, 2 (NSM). DUNDY COUNTY: 2½ mi. E Max, 1 (NSM); Rock Creek, N of Parks, 3; Republican River, 5 mi. E Parks, 1. HOLT COUNTY: Amelia, 9 (NSM). KEYA PAHA COUNTY: Holt Creek, 3 (AMNH); Burton Creek, 3 (AMNH); *Niobrara River,* 6 (AMNH). LANCASTER COUNTY: *1 mi. N Lincoln,* 1 (NSM); Lincoln, 1 (NSM); *1½ mi. SE Lincoln,* 1 (NSM); *4 mi. S Lincoln,* 1 (NSM). MADISON COUNTY: ¾ mi. E Norfolk, 1; *2 mi. E Norfolk,* 1. OTOE COUNTY: Nebraska City, 1 (USNM); Burr, 1 (NGFPC). PLATTE COUNTY: Columbus, 1 (NSM). ROCK COUNTY: *[Long] Pine Creek,* 10 (AMNH); head of Elkhorn River, 16 (AMNH); *Skull Creek, 30 mi. S Bassett,* 4 (AMNH); *Johnson Ranch, Skull Creek,* 1 (AMNH). SARPY COUNTY: Fontanelle Forest, 1 (RV). SAUNDERS COUNTY: *1½ mi. NE Ashland,* 1 (NSM); Ashland, 1 (NSM). SIOUX COUNTY: *7 mi. W Crawford,* 1 (NSM); 2 mi. W Glen, 1. STANTON COUNTY: 7 mi. E Norfolk, 1. WASHINGTON COUNTY: Blair, 6 (RV); Ft. Calhoun, 1 (RV).

Additional records (Swenk, MS, unless otherwise noted): ADAMS COUNTY: Logan Twp. CLAY COUNTY: vicinity Inland. CUMING COUNTY: West Point. LINCOLN COUNTY: no specific locality. THOMAS COUNTY: no specific locality (Smith, 1958:61). WASHINGTON COUNTY: *Engineer Cantonment* [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369).

Gulo luscus

Wolverine

The wolverine, a mammal of boreal affinities that occurs mostly in forested areas, formerly was distributed throughout most of the mountainous regions of the western United States and ranged eastward onto the Great Plains. It reached the southeastern limit of its distribution on the central plains in western Nebraska. Evidently the species never was common in the state, but it occurred certainly in the breaks along the North Platte River, evidently on the Pine Ridge (where Swenk, 1908:128, claimed it was several times reported), and possibly also on the pine-covered ridges of the Panhandle to the south of the Platte and along parts of the Niobrara River. Aughey (1880:120) noted that it was "found in central and western Nebraska" but that it was uncommon.

Only two definite records of the wolverine are available from the state. One is a mounted animal on display in the University of Nebraska State Museum that was taken in Scotts Bluff County (near Gering according to Swenk, MS) in 1887. The second is the

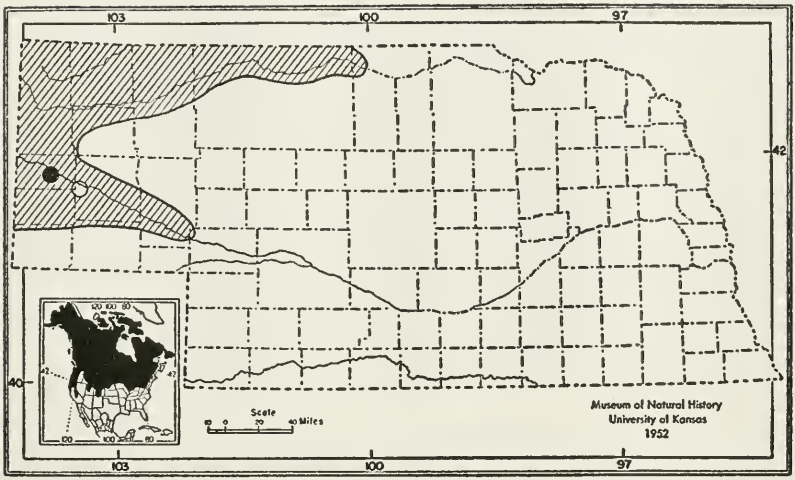

FIG. 64. Former distribution of *Gulo luscus luscus* in Nebraska. For explanation of symbols see Fig. 5.

report of an individual observed in the summer of 1837 near Chimney Rock by Alfred Jacob Miller (see Beidleman, 1956:445-446).

Recent records of *G. luscus* from Tama County, Iowa (Haugen, 1961:546), and from "near [south of] Timber Lake," Dewey Co., South Dakota (Lee, 1962:21), are of interest and may signal the eventual return to Nebraska of this interesting species.

Gulo luscus luscus (Linnaeus)

[Ursus] luscus Linnaeus, Systema naturae, ed. 10, 1:47, 1758 (type locality, "Hudsonis" [= Hudson Bay], Canada).

Gulo luscus, Sabine, *in* Franklin, Narrative of a journey to the shores of the Polar Sea . . . 1819-22, p. 650, 1823; Swenk, Proc. Nebraska Acad. Sci., 8:128, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:72, September, 1908; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Jones, Bull. Univ. Nebraska State Mus., 4:93, November 26, 1962.

Guleo [sic] luscus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Gulo luscus luscus, Hall and Kelson, The mammals of North America, p. 923, March 31, 1959.

G[ulo]. l[uscus]. luscus, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957.

Distribution in Nebraska.—Formerly in rough breaks along Platte River, on Pine Ridge, and in adjacent areas in western part of state; now extirpated. See Fig. 64.

Measurements.—Average external measurements (after Seton, 1929, 2:406) of four males and seven females are, respectively: 1051, 940.7; 212.5, 183.5; 198.5, 177.5. Adult males usually weigh 30-35 lbs., adult females, 20-25 lbs. Cranial measurements of a male from the Kettle River, British Columbia (KU

1486) are: greatest length, 167.0; condylobasal length, 149.0; zygomatic breadth, 104.5; mastoid breadth, 87.0; interorbital constriction, 40.9; postorbital constriction, 32.6; alveolar length of maxillary tooth-row, 52.4.

Remarks.—Degerbøl (1935:35-43), Rausch (1953:114-115), and others regarded *G. luscus* as conspecific with *G. gulo* of the Old World and employed the name *Gulo gulo luscus* for the wolverine that once occurred in Nebraska.

Records of occurrence.—Specimen examined, 1, as follows: SCOTTS BLUFF COUNTY: near Gering, 1 (NSM).

Additional records: MORRILL COUNTY: near Chimney Rock (Beidleman, 1956:446). County unknown: *Pine Ridge* (Swenk, 1908:128).

Taxidea taxus

Badger

Taxidea taxus is a relatively common inhabitant of the Sand Hills and High Plains of western Nebraska where its characteristic burrows, usually located on hillsides, provide reliable evidence of its presence and a reasonable index to local abundance. The species is not uncommon in some places in the eastern part of the state but there the activities of man have materially reduced suitable areas for location of burrows and may have affected adversely the potential supply of food. In sections of the state devoted principally to cultivation of crops burrow sites are found in pastures, along overgrown fencerows, and occasionally in cultivated fields.

The badger evidently is more abundant in eastern Nebraska now than at any time since the latter part of the last century. Aughey (1880:120) noted that it was "formerly common all over the State" but that it had been nearly "extirminated" from the eastern part. Swenk (1908:125-126) wrote of the species as follows: "Formerly common over the entire state, but of recent years becoming quite rare eastwardly, in some localities wholly extirpated. Westwardly it has managed to hold its own, and is still a characteristic animal of the plains. The past few years several have been recorded from eastern Nebraska. . . ."

The badger is of some economic importance as a predator on injurious rodents and as a fur-bearer; formerly the pelt was more valuable than now. Little is known concerning reproduction in the species. Females bear a single litter annually after a gestation period of about seven months. Gestation is lengthened by delayed implantation, a phenomenon that occurs in some other mustelids as well. According to Schwartz and Schwartz (1959:294) a litter consists of 1-7 young.

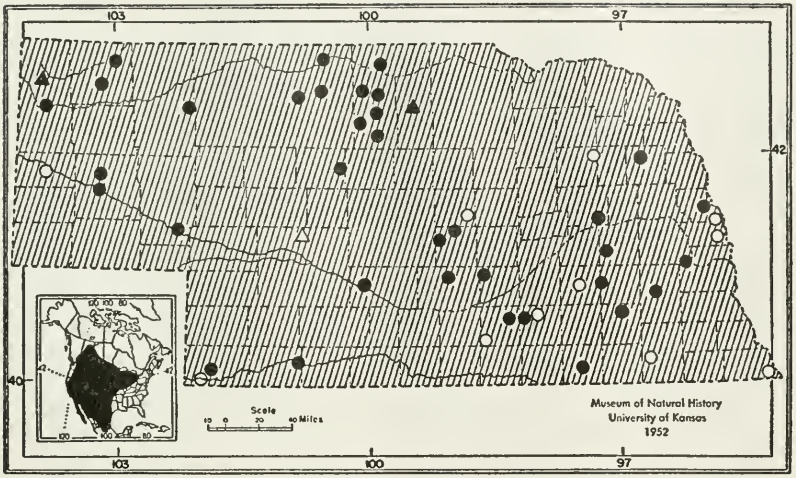

FIG. 65. Distribution of *Taxidea taxus taxus* in Nebraska. For explanation of symbols see Fig. 5.

Taxidea taxus taxus (Schreber)

Ursus Taxus Schreber, Die Säugthiere . . ., 3:589 (description on pp. 520-521), 1778 (type locality, "Labrador und um die Hudsonsbay," but the species is not known to occur at either of these places; "probably southwest of Hudson Bay" according to Miller and Kellogg, Bull. U. S. Nat. Mus., 205:747, March 3, 1955).

Taxidea taxus, Rhoads, Amer. Nat., 28:524, June, 1894; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:126, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:70, September, 1908; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920.

Taxus labradoricus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823 (*Meles labradoricus* used also, see p. 474).

Taxidea americana, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):202, July 14, 1858; Mearns, Bull. Amer. Mus. Nat. Hist., 3:240, June 5, 1891.

Taxidea Americana, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Taxidea taxus taxus, Swenk Nebraska Blue Book, p. 854, 1915; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Jones and Webb, Jour. Mamm., 30:313, August 17, 1949.

T[axidea]. t[axus]. taxus, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957 (*T. t. dakotensis [sic]* also mentioned as possibly applicable to Nebraskan badgers).

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 65.

Measurements.—External measurements of five males, the last two subadults, and one female from eastern Nebraska are, respectively: 735, 724, 740, 730,

741, 725; 122, 130, 150, 135, 132, 147; 98, 111, 110, 114, 107, 116; 47, —, 50, 52, 56, 51. One male weighed 19 lbs. 7 oz. and another 6.09 kg.; the female weighed 13¼ lbs.

Corresponding measurements of four males and two females from western Nebraska are, respectively: 787, 737, 709, 692, 762, 662; 134, 134, 109, 132, —, 104; 108, 117, 105, 116, 127, 98; —, —, —, —, 64, 32 (crown). The smallest male weighed 13 lbs.

Cranial measurements of four males from eastern Nebraska, the last two subadults, are as follows: condylobasal length, 125.1, 124.6, 128.2, 124.6; zygomatic breadth, 76.1, 79.0, 75.9, 81.4; interorbital constriction, 25.7, 25.4, 27.2, 27.4; postorbital constriction, 27.7, 25.3, 28.8, 30.4; mastoid breadth, 73.4, 73.7, 75.0, 75.3; palatal length, 63.9, ——, 67.2, 66.8; rostral breadth, 32.9, 34.0, 36.4, 34.3; length of maxillary tooth-row, 41.9, 38.4, 41.1, 42.5.

Corresponding measurements of three males and three females, the last a subadult, from central Nebraska are, respectively: 127.7, 125.7, 124.0, 121.5, 121.6, 119.6; 84.5, 81.0, 80.1, 77.8, 74.1, 71.5; 28.4, 29.3, 27.5, 27.3, 25.1, 25.5; 28.9, 29.0, 28.0, 25.8, 26.8, 26.4; 77.1, 76.2, 74.8, 72.3, 70.2, 70.5; 68.0, 67.2, 63.6, 63.2, 64.0, 62.4; 37.9, 35.1, 35.8, 34.0, ——, 32.2; 43.3, 41.9, 39.8, 41.2, 40.5, 41.2.

Corresponding cranial measurements for two males from northwestern Nebraska are: 129.5, 123.6; 87.7, 84.0; ——, 28.2; ——, 27.7; 80.8, 75.9; 68.3, 67.0; 38.2, ——; 43.0, 43.1.

Remarks.—North American badgers are in need of revisionary study. Such a study was begun nearly 20 years ago by Miss Viola S. Schantz of the U. S. Fish and Wildlife Service but, although she described 10 new subspecies over a period of several years, a final report, which theoretically would have clarified her views concerning noteworthy taxonomic characters and geographic variation in the genus, unfortunately never was issued. Prior to Schantz's work the subspecific name *T. t. taxus* generally was applied to badgers from a large segment of the northern part of the range of the species —from the northern limits south to approximately the 37th parallel, and from the eastern limits west to Nevada, Idaho, and Alberta (see Hall and Kelson, 1959:927). Seven of the subspecies named by her are from this region and some or all of the following six possibly relate to Nebraska, either because their type localities are near the borders of the state *(dacotensis, iowae, kansensis, merriami)* or because badgers from Nebraska were identified on specimen labels under the name by Schantz (*jacksoni, montana*—see also Schantz, 1953:389):

Taxidea taxus jacksoni, 1946 (type locality, 4 mi. E Milton, Rock Co., Wisconsin)

Taxidea taxus dacotensis, 1946 (type locality, Folsom, Custer Co., South Dakota)

Taxidea taxus iowae, 1947 (type locality, near Clarion, Wright Co., Iowa)

Taxidea taxus montana, 1950 (type locality, 35 mi. S Dillon, Beaverhead Co., Montana)

Taxidea taxus merriami, 1950 (type locality, Banner, Trego Co., Kansas)

Taxidea taxus kansensis, 1950 (type locality, McLouth, Leavenworth Co., Kansas)

Examination of Nebraskan badgers, some specimens from surrounding states, and the holotypes of the subspecies listed above impresses me with the wide range of variation present, both in color of pelage and in size and proportion of skull, and casts doubt in my mind on the validity of at least the majority of the subspecific names proposed by Schantz. Adequate material from a restricted geographic area needs to be studied critically to shed light on variation owing to age, season, and sex before geographic variation can be analyzed properly and the names proposed by Schantz dealt with in a meaningful way. Unfortunately, the specimens presently available from Nebraska are not suited for such an analysis because, aside from the fact that they originated from widely scattered localities, most lack critical data of some sort. The majority are skulls alone for example, some of which are broken, and many of which lack indication as to sex.

One thing that is apparent in the skins I have seen is that badgers from the Great Plains are paler on the average than those from the Central Lowlands to the east, being somewhat less blackish and having paler underfur dorsally, especially when animals taken in the same season are compared. Specimens from near the boundary between the two regions, as those listed beyond from Adams, Buffalo, Hall, and Sherman counties, tend to be intermediate in color. Baird (1858:203) and Mearns (1891:244) earlier noted the paleness of western badgers and it is reflected also in the several descriptions by Schantz. Possibly two subspecies could be recognized when (and if) the type locality and characters of the nominate subspecies, *T. t. taxus*, are better delimited. The latter name might apply either to the dark eastern population or to the paler badgers of the plains, or conceivably could be applicable to both.

Records of occurrence.—Specimens examined, 66, as follows: ADAMS COUNTY: Hastings, 2 (1 CNHM, 1 HM). BROWN COUNTY: *Bone Creek*, 1 (AMNH); Johnstown, 1 (USNM); near Ainsworth, 1 (AMNH); 12 mi. S Ainsworth, 1 (AMNH); Twin Lakes, T. 27 N, R. 24 W, 2 (AMNH); *Calamus River*, 2 (AMNH); 25 mi. S Ainsworth, 1 (AMNH). BUFFALO COUNTY: Pleasanton, 1 (NSM). BUTLER COUNTY: Rising City, 1 (RV). CHERRY COUNTY: Valentine, 1 (NSM); Valentine Nat'l Wildlife Refuge, 4 (1 NGFPC, 1 NSM); near Kennedy, 1. CLAY COUNTY: Inland, 4 (2 HM, 2 NSM). CUMING COUNTY: Beemer, 1 (USNM). DAWES COUNTY: Chadron, 1 (NSM); *near Chadron*, 1; about 15 mi. NE Marsland, 1 (NSM). DAWSON COUNTY: 4 mi. E Gothenburg, 2550 ft., 1 (UC). DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 1. GARDEN COUNTY: 4½ mi. NW Lewellen, 1. HALL COUNTY: 5 mi. W Cairo, 1 (NSM). HITCHCOCK COUNTY: "Republican Fork" [= E of Culbertson, specimen obtained on September 28, 1856], 1 (USNM). KEYA PAHA COUNTY: 7 mi. W Springview, 1 (UMMZ); *Burton Creek*, 2 (AMNH); *E Weston Ranch* (not exactly located), 1 (AMNH). LANCASTER COUNTY: *U. S. Hgy. 6, N of Lincoln*, 1; Lincoln, 1. MORRILL COUNTY: 9-10 mi. N Bridgeport, 4 (NSM); Bridgeport, 8 (NSM). PLATTE COUNTY: Columbus,

1 (USNM). ROCK COUNTY: Cameron Lake (not exactly located), 1 (AMNH); *Johnson Ranch, Skull Creek,* 1 (AMNH). SALINE COUNTY: 2 mi. E Dochester, 1. SAUNDERS COUNTY: Ashland, 1 (RV). SEWARD COUNTY: Utica, 1 (NSM). SHERIDAN COUNTY: Spring Lake Ranch (T. 29 N, R. 41 W), 1 (NGFPC). SHERMAN COUNTY: 6½ mi. NE Loup City, 1 (UNDZ); 8 mi. W. Loup City, 1 (NSM). SIOUX COUNTY: *1 mi. S Pants Butte* (not exactly located), 1; 3 mi. E Agate, 1; no specific locality, 1 (NGFPC). THAYER COUNTY: Hebron, 1 (NSM). THOMAS COUNTY: near Halsey, 1. WASHINGTON COUNTY: near Blair, 1. County unknown: *Loup Fork of the Platte,* 1 (USNM); *Platte River,* 1 (USNM).

Additional records (Swenk, MS, unless otherwise noted): ADAMS COUNTY: Logan Twp. CHERRY COUNTY: *Ft. Niobrara Nat'l Wildlife Refuge* (Beed, 1936:21); *20 mi. S Valentine* (record on file, NGFPC). CLAY COUNTY: Harvard. DOUGLAS COUNTY: near Omaha. DUNDY COUNTY: 7 mi. E Haigler (Jones, field notes). GAGE COUNTY: SW of Beatrice (record on file, NGFPC). LINCOLN COUNTY: Sand Hills, no specific locality. MADISON COUNTY: near Norfolk. RICHARDSON COUNTY: vicinity Rulo (Jones and Webb, 1949:313). SCOTTS BLUFF COUNTY: Scotts Bluff Nat'l Mon. (Mattes, 1958:57). VALLEY COUNTY, ¾ mi. N, 6 mi. W North Loup (Hill and Kivett, 1941:183, archeological site). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369). YORK COUNTY: near York.

Spilogale putorius

Spotted Skunk

The spotted skunk probably was confined to the southeastern part of Nebraska at the time of early settlement, if indeed it was then present at all within the borders of the state. James (1823:369) may have reported the species under the name "*Mephitis putorius*" from Major Long's Engineer Cantonment (winter of 1819-20) but the fact that he recorded only one kind of skunk casts doubt, in my mind at least, as to whether he was referring to *S. putorius* or instead to the striped skunk, *Mephitis mephitis.* Aughey (1880) did not record the spotted skunk in his list of Nebraskan mammals but I do not know whether its omission was intended or simply an oversight on Aughey's part. In any event, the species seems to have moved northward in the grasslands of the central United States in the wake of settlement of the region by European man (Van Gelder, 1959:271-272) and it must be admitted that there is no certain evidence that *S. putorius* occurred in what is now Nebraska in the early and middle 1800's.

There is no doubt, however, that the spotted skunk was in southeastern Nebraska in the latter part of the 19th Century for a specimen was taken at London in 1893. Swenk (1908:127) wrote of the species as follows: "This southern skunk is extending its way northwestward, and is apparently on the increase. The northwesternmost record I have is from Norfolk where several have been taken in recent years. . . ." *S. putorius* has spread westward in Nebraska so that its distribution now is state-wide. By 1907 it

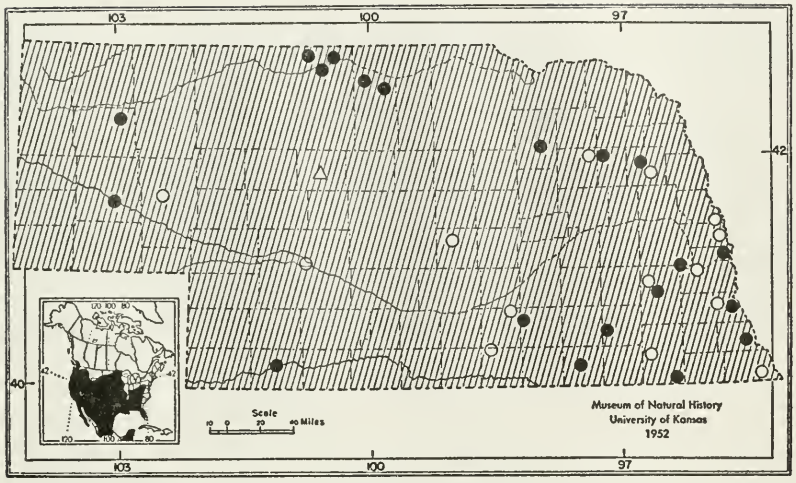

FIG. 66. Distribution of *Spilogale putorius interrupta* in Nebraska. For explanation of symbols see Fig. 5.

was reported in the Republican drainage in eastern Colorado (Van Gelder, *op. cit.*:271) and by 1912 had reached North Platte in the Platte drainage (Swenk, MS). Fichter (1944:18) reported individuals trapped in the 1942 season in every county except Box Butte, in which county a specimen subsequently has been taken.

In my experience the spotted skunk is relatively uncommon in Nebraska and is everywhere outnumbered by the larger striped skunk. There is some evidence, admittedly scanty, indicating that S. *putorius* is less numerous in eastern Nebraska now than, say, 30 years ago.

Females are said to bear litters of 2-7 young in late spring or early summer.

Spilogale putorius interrupta (Rafinesque)

Mephitis interrupta Rafinesque, Ann. Nat., 1:3, 1820 (type locality, "Louisiana;" restricted to upper Missouri River by Lichtenstein, Abh. K. Akad. Wiss. Berlin, for 1836, p. 281, 1838).

Spilogale putorius interrupta, McCarley, Texas Jour. Sci., 4:108, March 30, 1952; Van Gelder, Bull. Amer. Mus. Nat. Hist., 117:265, June 15, 1959.

?*Mephitis putorius*, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Spilogale interrupta, A. H. Howell, N. Amer. Fauna, 26:18, November 24, 1906; Swenk, Proc. Nebraska Acad. Sci. 8:127, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:71, September, 1908; Swenk, Nebraska Blue Book, p. 854, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936;

Whelan, Trans. Kansas Acad. Sci., 39:365, 1937; Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

S[pilogale]. p[utorius]. interrupta, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957.

Distribution in Nebraska.—State-wide, but commonest in eastern third. See Fig. 66.

External measurements.—Average and extreme measurements of five males, followed by measurements of two females, all from eastern Nebraska are: 516.7 (495-539), 508, 470; 205.2 (190-228), 203, 175; 48.0[4] (44-51), 45, 48; 28 (one male). Respective measurements of two males and a female from Cherry County and a male from Morrill County are: 584, 483, 530, 533; 229, 216, 197, 183; 48, 51, 51, 41. For cranial measurements see Table 21.

A young adult male from Gage County weighed 627.5 grams. Van Gelder (1959:269) reported the range in weight (grams) in the subspecies as 501-885 for males and 453-475 for females.

Remarks.—Van Gelder (1959:273), in discussing possible intergradation between *S. p. interrupta* and *S. p. gracilis* (the subspecies of the Rocky Mountains), commented as follows concerning two Nebraskan specimens: "A specimen from Valentine, Cherry County, Nebraska (U. S. N. M. No. 244349), has the terminal third of the tail white above, and the terminal ventral half white, far more white than is usual for *interrupta.* A second specimen from the same area (M. V. Z. No. 76235) is a skull only, with external measurements. If the latter (419, 191, 38) are to be trusted, the animal shows some characters of both *interrupta* and *gracilis.* The specimen in the United States National Museum does not have the external measurements recorded, but the skin appears to be about the same size as in *interrupta,* the tail being slightly shorter, but not so short as in *gracilis.* Cranially both of these specimens fall within the range of *interrupta,* but on an individual basis they show some characters more like those of *gracilis.* The color pattern of the skin is no whiter than in some specimens of *interrupta* from Oklahoma, and the nose patch, while slightly larger than in other Nebraskan specimens, is definitely smaller than is characteristic of *gracilis.* Were it not for the distinctly white-tipped tail of the one, these specimens would not have attracted attention; the possibility that this is an atavistic mutation, of course, exists."

Van Gelder's remarks deserve brief comment. I have examined four specimens from northeastern Cherry County (NSM 12621-24) that were not available to him and each is typical of *S. p. interrupta* in size and color. I also noted, independently, the peculiar coloration of the specimen in the U. S. National Museum but, in view of the normal coloration of the four individuals mentioned, regarded it simply as an unusual variant. I noted no cranial peculiarities except that the skull is unusually small for a male (see measurements); possibly the specimen was incorrectly sexed by the collector.

With regard to the second specimen (MVZ 76235), the external measurements are indeed small. This individual, a male, is a young adult, possibly accounting for its smallness, but the measurements may well be in error, as I judge Van Gelder suspected.

To sum up, specimens from Cherry County, everything considered, are assignable without question to *interrupta* and do not, to my mind, evidence intergradation with *gracilis*. Neither does a specimen from Box Butte County, farther west in the Niobrara drainage, nor one from along the North Platte River in Morrill County suggest such intergradation, strengthening the contention that the presence of spotted skunks in western Nebraska resulted from spread of the population to the east and not dispersal eastward into Nebraska from the west.

Records of occurrence.—Specimens examined, 49, as follows: ADAMS COUNTY: *no specific locality,* 1 (HM). ANTELOPE COUNTY: Neligh, 1 (USNM). BOX BUTTE COUNTY: 5 mi. E Hemingford, 1. BROWN COUNTY: Plum Creek, 1 (AMNH); Bone Creek, 1 (AMNH). CHERRY COUNTY: W of Crookston, 2 (NSM); Ft. Niobrara Nat'l Wildlife Refuge, 1 (NSM); *Valentine,* 1 (USNM); *Niobrara River,* 1 (NSM); sec. 34, T. 33 N, R. 28 W, 9 mi. SW Valentine, 1 (MVZ). CLAY COUNTY: Inland, 2 (1 HM, 1 NSM). CUMING COUNTY: Beemer, 6 (USNM). GAGE COUNTY: 2 mi. S, ½ mi. E Barnston, 1. HITCHCOCK COUNTY: Trenton, 1 (NSM). LANCASTER COUNTY: Lincoln, 14 (9 NSM, 1 UC, 2 UNDZ). MORRILL COUNTY: 3 mi. W Broadwater, 1 (NSM). NEMAHA COUNTY: London, 1 (USNM). OTOE COUNTY: Nebraska City, 1 (NGFPC). SALINE COUNTY: 4 mi. N Tobias, 1 (MVZ). SARPY COUNTY: Bellevue, 1 (RV); *Ft. Crook* (*"probably"*), 6 (AMNH). SAUNDERS COUNTY: near Ashland, 1 (NSM). STANTON COUNTY: Elkhorn River, 1 mi. S, 7 mi. E Norfolk, 1. THAYER COUNTY: Hebron, 1 (NSM).

Additional records (Swenk, 1908:127, unless otherwise noted): ADAMS COUNTY (Van Gelder, 1959:278): 5 mi. N Hastings; *near Hastings.* CASS COUNTY: South Bend. CUMING COUNTY: West Point. DOUGLAS COUNTY: Omaha. GAGE COUNTY: Beatrice. GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272). LANCASTER COUNTY: 9 mi. NW Lincoln (Whelan, 1937:365). LINCOLN COUNTY: North Platte (Swenk, MS). MADISON COUNTY: Norfolk. OTOE COUNTY: Dunbar. RICHARDSON COUNTY: Falls City (Cary, MS). SHERMAN COUNTY: Loup City (Swenk, MS). THOMAS COUNTY: no specific locality (Smith, 1958:62). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369). WEBSTER COUNTY: Bladen (Van Gelder, 1959:278).

Mephitis mephitis

Striped Skunk

Probably the striped skunk is the most abundant of Nebraskan mustelids. At any rate, the species certainly can be said to be common throughout the state. *M. mephitis* formerly was regarded as a valuable fur-bearer but the value of pelts has declined drastically in the past several decades, possibly accounting in part for the current abundance of this skunk.

According to Asdell (1946:148) females bear a single litter in spring that consists of 4-7 young.

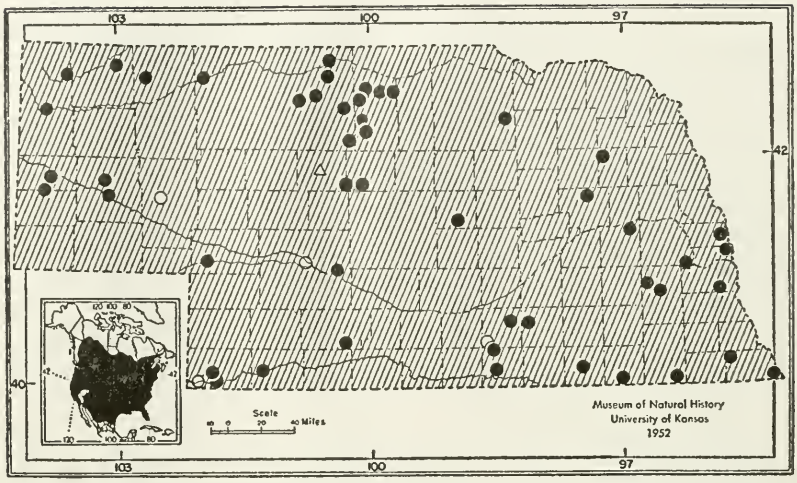

FIG. 67. Distribution of *Mephitis mephitis hudsonica* in Nebraska. For explanation of symbols see Fig. 5.

Mephitis mephitis hudsonica Richardson

Mephitis americana var. *hudsonica* Richardson, Fauna Boreali-Americana, 1:55, 1829 (type locality, plains of Saskatchewan, Canada).

Mephitis mephitis hudsonica, Hall, Univ. California Publ. Zool., 40:368, November 5, 1934; Hall and Kelson, The mammals of North America, p. 936, March 31, 1959 (part).

Mephitis mephitica, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880 (part).

M[ephitis]. occidentalis, Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880 (part).

Chincha hudsonica, A. H. Howell, N. Amer. Fauna, 20:24, August 31, 1901 (part).

Chincha mesomelas varians, A. H. Howell, N. Amer. Fauna, 20:31, August 31, 1901 (part).

Mephitis hudsonica, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:126, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:70, September, 1908 (part); Swenk, Nebraska Blue Book, p. 854, 1915 (part); Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 482, December, 1920 (part); Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Imler, Jour. Wildlife Mgt., 9:272, October, 1945.

Mephitis measomelas [sic] varians, Swenk, Proc. Nebraska Acad. Sci., 8:127, September, 1908 (part); Swenk, Studies Zool. Lab., Univ. Nebraska, 89:71, September, 1908 (part).

Mephitis mesomelas varians, Swenk, Nebraska Blue Book, p. 854, 1915 (part); Swenk, Nebraska Blue Book, p. 410, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 482, December, 1920 (part).

M[ephitis]. m[ephitis]. hudsonica, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957 (part).

M[ephitis]. m[ephitis]. varians, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957 (part).

Mephitis mephitis varians, Hall and Kelson, The mammals of North America, p. 937, March 31, 1959 (part).

Distribution in Nebraska.—State-wide. See Fig. 67.

External measurements.—Average and extreme measurements of seven males and six females from northwestern Nebraska are, respectively: 739.4 (710-795), 630.2 (560-656); 269.7 (246-295), 259.2 (225-277); 81.8 (78-85), 71.3 (68-74); 33.0[3] (30-35), 28.5 (26-30). The weight of four of the males averaged 8.7 (7.6-9.25) lbs., and three of the females weighed 4.1, 4.8, and 4.75 lbs.

Measurements of two males and three females from southeastern Nebraska are, respectively: 790, 720, 641, 592, 584; 295, 220, 217, 168, 255; 78, 73, 67, 67, 66; —, —, 33, 31, —. A male and female from Dundy County had the following respective measurements: 781, 664; 320, 266; 81, 65; 16, 15 (from crown). For cranial measurements see Table 21.

Remarks.—A revision of skunks of the genus *Mephitis* is long overdue. Until such a revision has been made, it seems best to refer all Nebraskan specimens to a single subspecies, *M. m. hudsonica,* although such a course is not adopted without some hesitation. A. H. Howell (1901), who last critically reviewed *Mephitis,* assigned Nebraskan specimens to two different kinds, *varians* and *hudsonica,* which he regarded as belonging to different species but which now are known (Hall, 1936:65-66) to be only subspecies of a single species. Subsequent authors (Swenk, 1908:126-127, Jones, 1957:280, Hall and Kelson, 1959:934-937, for example) have, following Howell, listed the subspecies *M. m. hudsonica* and *M. m. varians* as occurring in Nebraska but up to now no one has examined specimens critically.

A northward trend to larger size and a relatively (if not actually) shorter tail seemingly is present on the Great Plains and in adjacent regions; the smaller, longer-tailed *M. m. varians* (type locality, Texas) occurs in the southern part of the region and the larger, shorter-tailed *M. m. hudsonica* occupies the northern part. The part of the Great Plains that lies in Nebraska is near the middle (on the north-south axis) of the whole physiographic region and is almost equi-distant between the type localities of the two subspecies mentioned. By consequence, I expected to encounter difficulty in assigning to subspecies striped skunks from all parts of the state. Such, however, did not prove to be the case. Individuals from north-central and northwestern Nebraska are fairly typical of *hudsonica,* judging from Howell's (*op. cit.*:24, 44) brief description and measurements and from direct comparison with specimens from Minnesota. Specimens from south of the Platte River in the southwestern part of the state are, on the

average, slightly smaller and somewhat longer-tailed than those from the northwest and thus indicate a trend toward *varians*. Two individuals have a recorded length of tail in excess of 300 mm. (a male from Dundy County, 320, and a female from Frontier County, 310) but on the whole skunks from the southwest resemble specimens of *hudsonica* from Nebraska and elsewhere in external and cranial measurements to a much greater degree than they resemble specimens of *varians* from Texas, and on this basis are assigned to *hudsonica*.

The available specimens from the prairie area of eastern Nebraska resemble *hudsonica* in cranial measurements (see Table 21) but are shorter-tailed on the average, especially those from the southeast, and may evidence intergradation with *M. m. avia* (type locality, San Jose, Mason Co., Illinois), a subspecies that is poorly defined in the literature and of which I have not seen typical specimens. Judging from the original description of *avia* (Bangs, 1898:32-33) and from Howell's (*op. cit.*:30) descriptive remarks, specimens now available from eastern Nebraska are larger, both externally and cranially, than *avia* and do not possess, on the average, its alleged cranial peculiarities. All are therefore assigned to *M. m. hudsonica*. It should be noted that Cockrum (1952:257) assigned skunks from northeastern Kansas to *avia*, mostly on geographic grounds I suspect, and Scott (1937:62) used that name for specimens from southern Iowa. Specimens from northern Iowa (Scott, *loc. cit.*) and southeastern South Dakota (Findley, 1956*b*:26-27) have been referred to *hudsonica*.

In summary, materials at hand reveal, after individual variation has been taken into account, no basis for assigning more than one subspecific name to striped skunks from Nebraska even though some geographic variation is demonstrable. *Mephitis mephitis hudsonica* appears to be the name best applicable.

Records of occurrence.—Specimens examined, 239, as follows: ADAMS COUNTY: Hastings, 1 (HM); *no specific locality*, 1 (HM). BLAINE COUNTY: Dismal River, 9 mi. S Halsey, 1 (USNM); 3 mi. S Dunning, 1. BROWN COUNTY: Plum Creek, N of Johnstown, 2 (AMNH); *Plum Creek*, 5 (AMNH); [Long] Pine Creek, 1 (AMNH); Sand Draw, 2 (AMNH); *Bone Creek*, 2 (AMNH); *Johnstown*, 22 (USNM); 6 mi. SW Johnstown, 3 (AMNH); *Baxter Ranch* (not found), 1 (AMNH); Kirkpatrick Marsh (approximately 15 mi. S, 3 mi. W Johnstown), 17 (AMNH); Chain Lakes, NW ¼, T. 26 N, R. 23 W, 11 (AMNH); *Calamus River*, 19 (AMNH). BUTLER COUNTY: 9 mi. NE David City, 2. CASS COUNTY: 34 mi. E Lincoln (on U. S. Hgy. 34), 1 (UC). CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge, 2 (NSM); *4 mi. E Valentine*, 1; *Valentine*, 2 (1 USNM); *3 mi. S Valentine*, 1; *Niobrara River*, 1 (NSM); sec. 9, T. 32 N, R. 28 W, 12 mi. S [=8 mi. SSE] Valentine, 1 (MVZ); 12 mi. SE Gordon, 1 (CNHM); *Valentine Nat'l Wildlife Refuge*, 18 (16 NSM); Hackberry Lake, Valentine Nat'l Wildlife Refuge, 3 (2 UMMZ); Kennedy, 4 (USNM); *near Kennedy*,

TABLE 21.—CRANIAL MEASUREMENTS OF SPILOGALE PUTORIUS AND MEPHITIS MEPHITIS.

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Zygomatic breadth	Postorbital constriction	Mastoid breadth	Palatal length	Length of maxillary tooth-row
Spilogale putorius interrupta, eastern Nebraska						
Average 9 (♂)	58.7	35.9	15.1	32.0	22.3	17.5
Minimum	57.2	35.1	14.5	29.7	21.2	16.5
Maximum	61.4	37.0	15.6	33.2	23.6	18.8
Beemer, Cuming County						
147751 USNM, ♀	54.9	33.3	14.1	30.1	21.2	16.5
Cherry County						
12622 NSM, ♂	58.8	34.5	14.9	31.3	23.0	17.9
12623 NSM, ♂	59.1	35.1	14.7	31.1	22.3	17.6
224349 USNM, ♂*	54.3	32.5	14.3	27.8	20.0	15.9
12621 NSM, ♀	54.2	33.3	14.1	29.0	21.0	17.2
12624 NSM, ♀	54.0	31.4	13.5	28.0	21.0	16.5
3 mi. W Broadwater, Morrill County						
3340 NSM, ♂	57.6	34.5	14.5	31.6	22.2	17.0
Mephitis mephitis hudsonica, northwestern Nebraska						
Average 17 (♂)	79.6	50.9	20.1	43.5	31.0	23.0
Minimum	77.7	48.6	18.9	42.5	29.8	21.8
Maximum	81.3	57.1	21.2	47.1	32.0	24.0
Average 14 (♀)	70.6	45.7	19.2	38.1	28.3	21.8
Minimum	66.5	43.4	18.2	34.0	26.5	21.0
Maximum	73.7	47.7	20.5	41.1	29.5	22.7
Lancaster County						
106 NSM, ♂	80.2	48.7	20.3	42.1	31.7	23.0
1875 NSM, ♂	80.5	.....	20.9	43.3	32.0	23.1
Southeastern Nebraska						
Average 8 (♀)	71.6	45.7	19.0[6]	38.1	29.0	21.6
Minimum	69.3	43.6	17.2	36.7	27.0	20.5
Maximum	74.2	47.0	20.5	40.7	30.7	23.4
Dundy County						
72658 KU, ♂	77.1	48.7	19.4	41.3	30.4	23.1
72657 KU, ♀	67.4	43.8	19.3	36.5	27.4	20.9

* Sex possibly recorded incorrectly (see text).

11; *Schleuter Ranch, sec. 13, T. 29 N, R. 26 W*, 12 (AMNH); 30 mi. S Woodlake, 1 (CNHM); *Goose Creek*, 1 (AMNH); *no specific locality*, 1 (USNM). CLAY COUNTY: Inland, 6 (5 HM, 1 NSM). DAWES COUNTY: Chadron, 3 (NSM); *3 mi. W Crawford*, 1 (NSM); 4 mi. SW Crawford, 1 (NSM). DOUGLAS COUNTY: Florence, 1 (RV); Omaha, 2 (RV). DUNDY COUNTY: 5 mi. N, 2 mi. W Parks, 3; *1 mi. N, 1 mi. W Parks*, 1; S of Parks,

1 (NGFPC). FRONTIER COUNTY: 15 mi. SE Stockville, 3 (NSM). GAGE COUNTY: 2 mi. S, ½ mi. E Barnston, 1. HITCHCOCK COUNTY: 1 mi. ENE Stratton, 1. HOLT COUNTY: Page, 1 (NSM). JEFFERSON COUNTY: 3 mi. S, 1 mi. W Endicott, 1. KEITH COUNTY: Brule, 1 (NSM). LANCASTER COUNTY: Malcolm (T. 10 N, R. 5 E), 1 (NSM); Lincoln, 6 (NSM); *3½ mi. SE College View (Lincoln),* 1 (UC); *5 mi. S Lincoln,* 1 (UC). LINCOLN COUNTY: Sandhills N of Brady, 1 (NSM). MORRILL COUNTY: 9 mi. N Bridgeport, 6 (NSM); *approximately 4 mi. N Bridgeport,* 1 (NSM); *Bridgeport,* 1 (NSM); 3 mi. E Bridgeport, 1 (NSM). PLATTE COUNTY: Humphrey, 1 (RV). RICHARDSON COUNTY: 5 mi. N, 2 mi. W Humboldt, 1; 3 mi. S Rulo, 1. SARPY COUNTY: Bellevue, 1 (RV). SAUNDERS COUNTY: Ashland, 1 (NSM). SCOTTS BLUFF COUNTY: 1½ mi. S Gering, 2 (NSM); 12 mi. SSW Scottsbluff, 4700 ft., 2. SHERIDAN COUNTY: 4½ mi. NE Hay Springs, 1. SIOUX COUNTY: 5½-6½ mi. W Crawford, 9 (NSM); 3 mi. E Agate, 3. STANTON COUNTY: Elkhorn River, 7 mi. E, 1 mi. S Norfolk, 1. THAYER COUNTY: Hebron, 2 (NSM). VALLEY COUNTY: sec. 1, Yale Twp. (approximately 9 mi. S, 3 mi. W Ord), 1 (NGFPC). WEBSTER COUNTY: Bladen, 5 (AMNH); 5 mi. N, 3 mi. W Red Cloud, 1 (NSM). County unknown: *Loup Fork,* 1 (USNM); *vicinity Republican River between Red Cloud and Superior,* 3 (NSM); *"Nebraska" [possibly Ft. Crook],* 5 (AMNH).

Additional records: ADAMS COUNTY: Logan Twp. (Swenk, MS). DUNDY COUNTY: Haigler (Swenk, 1908:126). GARDEN COUNTY: Crescent Lake Nat'l Wildlife Refuge (Imler, 1945:272). LINCOLN COUNTY: vicinity North Platte (Swenk, MS). RICHARDSON COUNTY: *4 mi. SE Rulo* (Hill and Wedel, 1936:63, archeological site). THOMAS COUNTY: no specific locality (Smith, 1958:61).

Lutra canadensis

Otter

The otter was common along the waterways of the state in historical times and early explorers along the Missouri and the Platte took frequent note of the species in their journals. Pelts were highly prized and much sought by trappers and traders. Aughey (1880:120) noted that the species was "found more or less abundantly in all the rivers of Nebraska." Later, Swenk (1908:132) wrote as follows: "The Otter was formerly very common along all our streams but has become less so year by year until now it is rare. It is not yet extirpated, however, since every year numerous specimens are taken even in the eastern counties. . . ."

Pressure from trapping, pollution of streams, and destruction of original stream-side habitats finally led to the extirpation of the species in Nebraska. The most recently taken specimen is an adult male that was found dead on June 4, 1916, along Lincoln Creek in Seward County. The last report of *L. canadensis* from the state of which I have record is of tracks seen on November 8, 1918, along a tributary of the Republican River in Phelps County.

The otter has been extirpated over most if not all of its former range on the central Great Plains and in adjacent areas to the east. The species still occurs, however, along the Mississippi River in Iowa and Missouri and it seems likely that in time it may

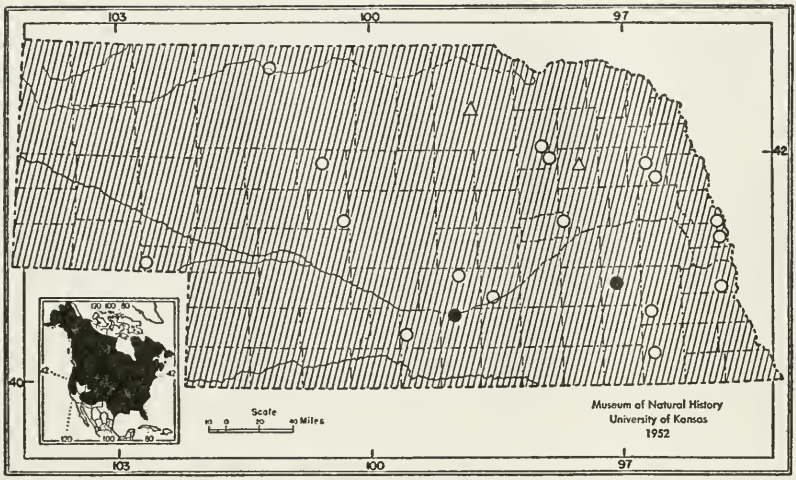

FIG. 68. Former distribution of *Lutra canadensis interior* in Nebraska. For explanation of symbols see Fig. 5.

again reach Nebraska along the Missouri River. Sewage abatement programs now in progress or under study, along with complete protection of the species and the increasing acreage along the Missouri and its major tributaries that is being devoted to conservation programs, may provide satisfactory conditions for the return of the otter.

Lutra canadensis interior Swenk

Lutra canadensis interior Swenk, Univ. Nebraska Studies, 18:2, May 15, 1920 (type locality, Lincoln Creek, W of Seward, Seward Co., Nebraska); Swenk, Nebraska Blue Book, p. 411, December, 1918 *(nomen nudem)*; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 *(nomen nudem)*; Swenk, Nebraska Blue Book, p. 483, December, 1920; Swenk, Nebraska Bird Review, 5:55, July 31, 1937; Cockrum, Univ. Kansas Publ., Mus. Nat. Hist., 7:267, August 25, 1952; Hall and Kelson, The mammals of North America, p. 945, March 31, 1959; Velich, Jour. Mamm., 42:93, February 20, 1961; Jones, Bull. Univ. Nebraska State Mus., 4:93, November 26, 1962.

Lutra (*mustela lutra Braziliensis* Gm. Cuv.), James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

Lutra canadensis, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):184, July 14, 1858; Hayden, Exec. Doc., House of Representatives, 2nd Sess., 35th Cong., 2:708, 1859; Hayden, Catalogue of the collections in geology and natural history . . ., *in* Warren, Preliminary report of explorations in Nebraska and Dakota . . ., p. 92, 1875.

Lutra Canadensis, Hayden, Trans. Amer. Philos. Soc., 12 (n. s.):143, 1863; Aughey, Sketches of the physical geography and geology of Nebraska, p. 120, 1880.

Lutra candensis [sic] sonora, Swenk, Proc. Nebraska Acad. Sci., 8:132, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:76, September, 1908.

L[utra]. c[anadensis]. interior, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957.

Distribution in Nebraska.—Formerly state-wide in suitable habitat; now absent. See Fig. 68.

Measurements.—External and cranial measurements of the male holotype (after Swenk, 1920*a*:3-4) are 1346; 457; 120; 16.5 (the first two measurements taken in inches by the collector, the last two taken by Swenk from the skin); condylobasal length, 112.0; basilar length, 103.0; zygomatic breadth, 74.5; mastoid breadth, 66.5; interorbital constriction, 24.0; postorbital constriction, 21.5.

Remarks.—In using the name *L. c. interior* I am mindful that it was based on a single specimen and that its distinctness, especially from *L. c. canadensis,* never has been subjected to critical evaluation.

According to the original description, *interior* differs from *canadensis* in being slightly paler, larger, and in having a proportionately shorter hind foot, proportionately smaller skull, and less crowded teeth. Only four specimens of the species are known from Nebraska (see list beyond and Velich, 1961:93). One is a young female of which the skull alone now remains; two are from along the Missouri River, are mounted, of unknown sex, and were prepared before 1900; and the fourth is the type specimen of *interior,* now housed with the other holotypes of mammals named by Swenk in the Museum of Vertebrate Zoology at the University of California.

Swenk (1918:411 and 1919:20) twice used the name *Lutra canadensis interior* as a *nomen nudum.* The original description was submitted for publication in volume 18 of the University of Nebraska Studies, which was scheduled for issue in 1918 but actually was not published until 1920. In the meantime Swenk, apparently anticipating the publication of the description, listed the name in his checklists of 1918 and 1919.

Records of occurrence.—Specimens examined, 3, as follows: KEARNEY COUNTY: Ft. Kearney, 1 (USNM). SEWARD COUNTY: Lincoln Creek, W of Seward (holotype), 1 (MVZ). County unknown: *Missouri River,* 1 (NSM).

Additional records (Jones, 1962:94, unless otherwise noted): ANTELOPE COUNTY: Neligh; Oakdale. BUFFALO COUNTY: along South Loup River. CASS COUNTY: Weeping Water Creek. CHERRY COUNTY: Niobrara River, S of Cody. CUMING COUNTY: Elkhorn River, near West Point (Swenk, 1920*a*: 1); Elkhorn River, near Beemer. DEUEL COUNTY: Lodgepole Creek, 22 mi. from Julesburg, Colorado. DOUGLAS COUNTY: Missouri River (Velich, 1961:93). GAGE COUNTY: Blue River, near Beatrice (Swenk, 1920*a*:2). HALL COUNTY: vicinity Wood River; *no specific locality.* HOLT COUNTY: no specific locality. LANCASTER COUNTY: Salt Creek, near Sprague (Swenk, 1920*a*:1). LOGAN COUNTY: South Loup River, near Logan. MADISON

COUNTY: no specific locality. NANCE COUNTY: vicinity Genoa. PHELPS COUNTY: W of Loomis. THOMAS COUNTY: Middle Loup River. WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369). County unkown: *Niobrara River, about 80 mi. above its mouth* (Hayden, 1859:708).

Family FELIDAE—Cats

KEY TO NEBRASKAN FELIDS

1. Tail more than twice length of hind foot; premolars 3/3; zygomatic breadth more than 110 ..... *Felis concolor*, p. 299
1′. Tail shorter than hind foot; premolars 2/2; zygomatic breadth less than 110 2
2. Tip of tail black all around; jugular foramen separate from anterior condyloid foramen ..... *Lynx canadensis*, p. 302
2′. Black at tip of tail restricted to dorsal blotch; jugular foramen and anterior condyloid foramen confluent ..... *Lynx rufus*, p. 304

Felis concolor

Mountain Lion

The mountain lion, or puma as it sometimes is called, evidently occurred throughout Nebraska but probably was more abundant in the west than in the east. Excepting some of the rough country in the Panhandle the species likely was more or less associated with the wooded borders of streams and rivers and the wooded areas adjacent to the Missouri River in the eastern part of the state—at least the available records suggest that this was the case.

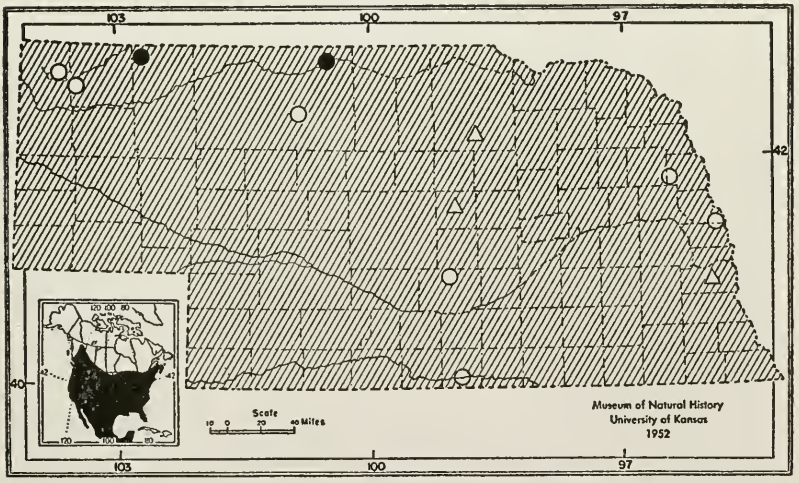

FIG. 69. Former distribution of *Felis concolor hippolestes* in Nebraska. For explanation of symbols see Fig. 5.

The latest records of the mountain lion in eastern and central Nebraska are in the 1880's and 1890's. Aughey (1880:119) noted that he had seen lions "a few times on the Niobrara and the Loup" and according to Swenk (1908:116) the species was still extant in southern Holt County as late as 1899. *F. concolor* survived into the early 1900's in the Pine Ridge country where the last report of which I have record is of an individual seen by D. W. Lindeman and his brother in 1903 on their farm on Deadmans Creek, 7 mi. S and 3½ mi. W Crawford. The Lindeman brothers also recalled seeing a lion that was killed in the middle 1890's near the head of Soldier Creek, Sioux County.

Almost every year there are newspaper reports of mountain lions at various places in Nebraska but none of these has yet been verified by the taking of a specimen or even by a sight record made by a qualified observer. Reports are most persistant from the Pine Ridge area and it is possible that individuals have wandered there from adjacent Wyoming in recent years. John Mathisen, District Game Supervisor for the Nebraska Game, Forestation and Parks Commission, reported (*in litt.*, May 9, 1960) that the late Harold Cook had a cast of what was thought to be the track of a mountain lion from along the Niobrara River at Agate and also that two lions were killed in the winter of 1959-60 in the vicinity of Van Tassel, Wyoming, just across the state border from Sioux County. The admission of *F. concolor* to the list of extant species in Nebraska must await, however, a time when concrete evidence of its presence is at hand.

According to Young (1946:114) females breed once every two or three years and give birth to 1-6 young, which are born at any time of year. A female taken on the Pine Ridge near [north of] Hay Springs in the winter of 1884 was accompanied by two cubs (Swenk, 1908:117).

Felis concolor hippolestes Merriam

Felis hippolestes Merriam, Proc. Biol. Soc. Washington, 11:219, July 15, 1897 (type locality, Wind River Mts., near head of Big Wind River, Fremont Co., Wyoming); Swenk, Proc. Nebraska Acad. Sci., 8:117, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:61, September, 1908.

Felis concolor hippolestes, Nelson and Goldman, Jour. Mamm., 10:347, November 11, 1929.

Felis concolor, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823; Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880; Jones, Jour. Mamm., 30:313, August 17, 1949; Jones, Bull. Univ. Nebraska State Mus., 4:94, November 26, 1962.

Felis oregonensis hippolestes, Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:19, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920.

F[elis]. c[oncolor]. hippolestes, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957.

Distribution in Nebraska.—Formerly state-wide in suitable habitat; now extirpated. See Fig. 69.

Measurements.—No external measurements of Nebraskan specimens are available. Goldman (1946:210) recorded the respective total lengths of three males and three females from the vicinity of Meeker, Colorado, as 2438, 2336, 2286, 2134, 2058, and 2006, and the respective weights (lbs.) of the same six individuals as 227, 164, 160, 133, 124, and 120. Some cranial measurements of a female from near Hay Springs are: zygomatic breadth, 138.6; mastoid breadth, 82.3; breadth across postorbital processes, 79.9; interorbital constriction, 39.7; postorbital constriction, 42.0; alveolar length of maxillary tooth-row, 61.1. See Goldman *(loc. cit.)* for cranial measurements of Coloradan specimens.

Remarks.—The name *F. c. hippolestes* is here applied to mountain lions from all of Nebraska because the two available specimens, a mounted animal of unknown sex taken in 1880 near Valentine and the skull only of an adult female obtained in 1884 on the Pine Ridge near [north of] Hay Springs, seem to be referable to that race rather than to *F. c. schorgeri* of the Mississippi Valley. The mounted specimen approaches *hippolestes* in color, being pale brownish over-all and not "dark and reddish" as *schorgeri* is alleged to be. Probably the skin of the Nebraskan specimen has faded somewhat inasmuch as it has been displayed for most of the 80 odd years since the animal was killed, but probably it is comparable with the skin of the holotype of *schorgeri*, obtained in 1857, which was originally mounted and later was removed and tanned. Measurements of the skull of the female from the vicinity of Hay Springs are only slightly larger than those listed by Goldman (1946:210) for two adult females from the vicinity of Meeker, Colorado.

It is possible that the eastern part of Nebraska was within the former range of *F. c. schorgeri* because a specimen from Ellis County, Kansas, was one of three upon which Jackson (1955:149-150) erected the name. The subspecies *schorgeri* now is extinct.

Records of occurrence.—Specimens examined, 2. as follows: CHERRY COUNTY: near Valentine, 1 (NSM). SHERIDAN COUNTY: Pine Ridge, near [N of] Hay Springs, 1 (NSM).

Additional records (Jones, 1962:94-95, unless otherwise noted): BUFFALO COUNTY: South Loup River, 22 mi. N Kearney. BURT COUNTY: about 3 mi. W Oakland. CASS COUNTY: no specific locality. CHERRY COUNTY: S of Kennedy. DAWES COUNTY: 7 mi. S, 3½ mi. W Crawford (see text). FRANKLIN COUNTY: Republican River, S of Franklin (Jones, 1949*a*:313). HOLT COUNTY: southern part (Swenk, 1908:117). SIOUX COUNTY: head

of Soldier Creek (see text). VALLEY COUNTY: no specific locality. WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:169).

Lynx canadensis

Lynx

Lynx canadensis is typical of the boreal forests of North America. The range of the species in Nebraska is not well documented but the lynx probably occurred sparingly on the Great Plains in suitable habitat at least as far south as the Platte River. It is thought now to be absent from the state.

A single specimen is preserved from Nebraska—a mounted individual of unknown sex that was shot from a cottonwood tree near Norfolk (along the Elkhorn River, 3 mi. W Norfolk according to Cary, MS) in November of 1890. A second individual, a

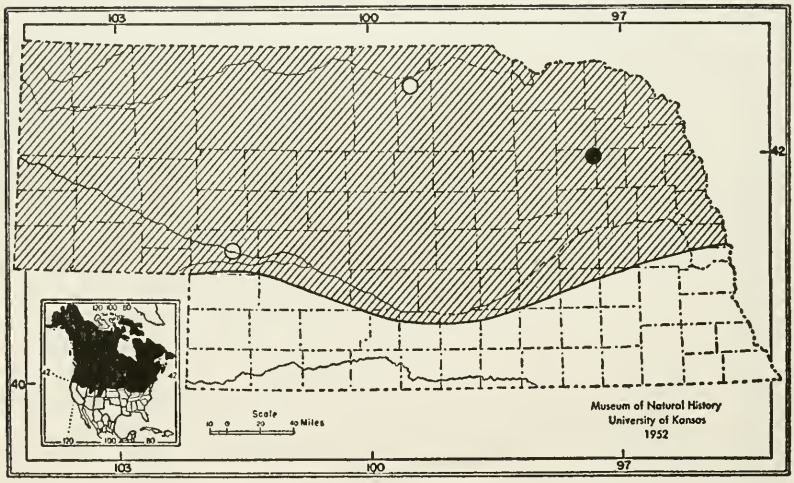

FIG. 70. Former distribution of *Lynx canadensis canadensis* in Nebraska. For explanation of symbols see Fig. 5.

small female weighing only 18 pounds, was killed along the North Platte River at Cedar Point, near Keystone, in February of 1917. This animal was later mounted and was exhibited for a time in Lincoln but its present location is unknown and in may no longer be extant. I have a photograph of the last-mentioned individual.

A possible third record of *L. canadensis*, which I am inclined to credit, is revealed by four separate newspaper articles among Swenk's (MS) unpublished notes. In mid-March of 1915 two

boys treed and shot a large cat in a grove not far from the Niobrara River, 7 mi. NE Bassett. The animal was identified by an experienced trapper as a "Canadian lynx," was reported to have weighed "about 60" pounds, to have had paws larger than the hand of man, tufts on the ears that were two and a half inches long, and a length in excess of 36 inches. Swenk attempted unsuccessfully to obtain the animal for the collections of the University of Nebraska.

Additional references to the lynx may be found in the historical literature dealing with Nebraska. I have found "lynx" mentioned several times in historical accounts but in each case it was not possible to ascertain certainly whether the citation pertained to *L. canadensis* or instead to the bobcat, *L. rufus*. Probably most references were to the latter species.

[After preparation of the present account I received information from William J. Bailey *(in litt.)* that he and two other biologists examined a mounted lynx at Ewing, Holt County, that was reportedly taken along Little Swamp Creek, 4½ mi. W Ewing on November 27, 1958. Of additional note is the shooting of a lynx on May 6, 1962, near Marindahl, Yankton Co., South Dakota (Lee 1962:21), a locality only 12 miles north of the Nebraska (Cedar County) border.]

Lynx canadensis canadensis Kerr

Lynx canadensis Kerr, The animal kingdom . . ., 1: systematic catalogue inserted between 32-33 and 157, 1792 (type locality restricted to Province of Quebec, Canada, by Miller and Kellogg, Bull. U. S. Nat. Mus., 205:777, March 3, 1955); Jones, Bull. Univ. Nebraska State Mus., 4:95, November 26, 1962.

Lynx Canadensis, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880.

Lynx canadesis [sic], Swenk, Proc. Nebraska Acad. Sci., 8:118, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:62, September, 1908.

Lynx canadensis canadensis, Swenk, Nebraska Blue Book, p. 853, 1915; Swenk, Nebraska Blue Book, p. 410, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919; Swenk, Nebraska Blue Book, p. 482, December, 1920; Hall and Kelson, The mammals of North America, p. 967, March 31, 1959.

L[ynx]. c[anadensis]. canadensis, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957.

Distribution in Nebraska.—Formerly northern part of state, south at least to Platte River; present status unknown, possibly extirpated. See Fig. 70.

Measurements.—Cowan and Guiguet (1960:343) recorded the extremes in external measurements of three males and four females from British Columbia, respectively, as follows: 864-927, 876-902; 102-114, 97-127; 235-267, 222-242. Adult individuals of *L. canadensis* generally weigh between 25 and 35 lbs. Cranial measurements of a male (KU 2190) from the

Kettle River, British Columbia, are: greatest length, 133.0; condylobasal length, 122.2; zygomatic breadth, 94.2; interobital constriction, 31.3; postorbital constriction, 38.1; mastoid breadth, 57.1; length of nasals, 36.6; breadth across postorbital processes, 63.6; alveolar length of maxillary toothrow, 41.6.

Records of occurrence.—Specimen examined, 1, as follows: MADISON COUNTY: 3 mi. W Norfolk, 1 (NSM).

Additional records: KEITH COUNTY: Cedar Point, near Keystone (see text). ROCK COUNTY: 7 mi. NE Bassett (see text).

Lynx rufus

Bobcat

The bobcat is the only native felid certainly extant within the borders of Nebraska. It is fairly common in some northern and western parts of the state, especially the Wildcat and Bighorn ridges, the breaks along the North Platte River, the Pine Ridge and adjacent Badlands, and along the Niobrara and northern Missouri rivers. Elsewhere the species occurs sparingly, mostly in timbered sections, except that it is evidently rare or absent in parts of the state south of the Platte River; the most recent record of an animal from southern Nebraska is of an individual taken along Lost Creek, Franklin County, in the winter of 1920-21 (Swenk, MS). Velich (1958:148) suggested that the present distribution of *L. rufus* in Nebraska was "limited to more heavily wooded areas from the Platte River Valley northward." Earlier,

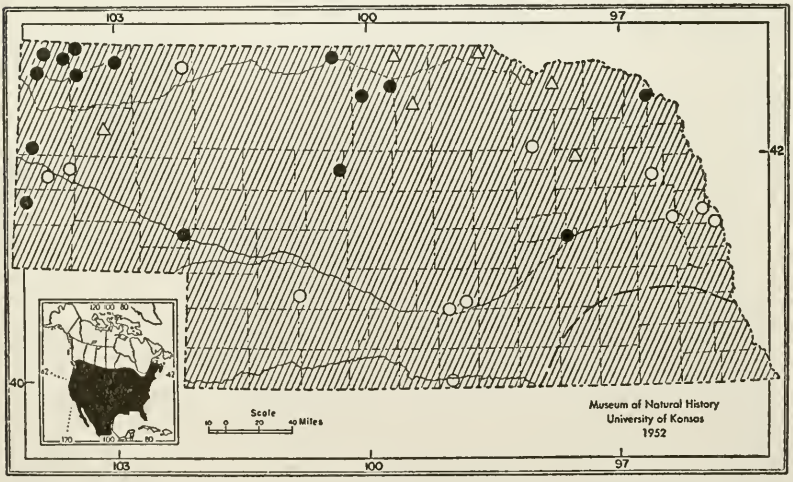

FIG. 71. Distribution of *Lynx rufus rufus* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate southeastern limit of present distribution.

Swenk (1908:118) noted that, at that time, the bobcat was "less common than formerly" but that individuals were "shot almost every year even in the more thickly settled districts of eastern Nebraska."

Gashwiler *et al.* (1961) found gravid females in Utah in every month from January through September (most in March and April) and lactating animals from March through September. They reported that 356 pregnant females carried an average of 3.2 (1-8) embryos; the mode was 3.

Lynx rufus rufus (Schreber)

Felis rufa Schreber, Die Säugthiere . . ., 3:pl. 109b, 1777 (type locality, New York).

Lynx rufus Rafinesque, Amer. Monthly Mag., 2:46, November, 1817; Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

[Felis] rufa, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:369, 1823.

L[ynx]. fasciatus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 119, 1880 (part).

Lynx rufus?, Cary, Proc. Nebraska Ornith. Union, 3:68, 69, December, 1902.

Lynx ruffus, Swenk, Proc. Nebraska Acad. Sci., 8:118, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:62, September, 1908; Swenk, Nebraska Blue Book, p. 411, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 482, December, 1920 (part).

Lynx ruffus ruffus, Swenk, Nebraska Blue Book, p. 853, 1915 (part).

Lynx baileyi, Swenk, Nebraska Blue Book, p. 853, 1915 (part); Swenk, Nebraska Blue Book, p. 411, December, 1918 (part); Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:20, March 1, 1919 (part); Swenk, Nebraska Blue Book, p. 482, December, 1920 (part).

L[ynx]. r[ufus]. rufus, Jones, Trans. Kansas Acad. Sci., 60:280, October 22, 1957 (*L. r. uinta* and *L. r. baileyi* also mentioned as possibly occurring in Nebraska); Velich, Jour. Mamm., 39:148, February 20, 1958.

Lynx rufus rufus, Velich, Jour. Mamm., 35:429, August 20, 1954.

Distribution in Nebraska.—Formerly state-wide; possibly presently so, but rare except along parts of Niobrara and Missouri rivers and in some sections of Panhandle. See Fig. 71.

External measurements.—Measurements of a male from Cherry County and a male and three females from Sioux County are, respectively (all females young adults): 940, 996, 824.5, 813, 848; 152, 160, 162, 152, 134; 190, 178, 165, 178, 178; —, —, 80, —, 78. For cranial measurements see Table 22.

The male from Sioux County and two of the females weighed, respectively, 23, 17¾, and 14¾ lbs. A male from Merrick County weighed 29½ lbs. (Velich, 1954:429), and a young male from Washington County weighed 22 lbs. (Velich, 1958:148); two males from northwestern Dawes County weighed 29 and 25¾ lbs. (Young, 1958:17).

Remarks.—Reference of all Nebraskan bobcats to the subspecies *L. r. rufus* is tentative. Final allocation of subspecific

names must await a time when more specimens are available from Nebraska and neighboring plains states. No skins from the eastern part of the state have been available for study but I would expect bobcats from there to resemble in color of pelage those from adjacent parts of South Dakota, Iowa, and Kansas, all of which have been referred to *L. r. rufus* (Findley, 1956*a*:29, Scott, 1937:67, and Cockrum, 1952:265, respectively). The two skulls presently available from eastern Nebraska (Dixon and Merrick counties) do not differ appreciably from skulls of *rufus* with which they were compared.

Specimens from north-central and northwestern Nebraska (Brown, Cherry, Dawes, and Sioux counties) are distinctly paler and more reddish than individuals examined from Missouri and eastern Kansas but are not so pale and indistinctly marked as typical *L. r. pallescens* (or *L. r. uinta*, regarded as a synonym of *pallescens* by Grinnell and Dixon, 1924:350-351) from the Great Basin region. Cranially the Nebraskan specimens resemble those seen of *rufus* but average smaller than the measurements given for that subspecies by Peterson and Downing (1952:10).

Swenk (1915*c*:853 and elsewhere) employed the subspecific name *baileyi* for bobcats from western Nebraska, probably on geographic grounds. Specimens examined from the western part of the state, however, are darker, more conspicuously mottled, and larger in both external and cranial measurements than *baileyi*. Perhaps as Peterson and Downing (*op. cit.*:15) pointed out, ". . . the bobcats of the plains region of the central United States may represent an undescribed race."

Records of occurrence.—Specimens examined, 30, as follows: BANNER COUNTY: 10 mi. W Harrisburg, 1 (NSM). BROWN COUNTY: [Long] Pine Creek, 2 (AMNH); Johnstown, 2 (USNM); *near Johnstown*, 1 (AMNH). CHERRY COUNTY: Ft. Niobrara Nat'l Wildlife Refuge, 4 (2 NSM, 2 USNM); *Niobrara River*, 2 (Dickey Coll.). DAWES COUNTY: NW corner (Jim Moody's Ranch), 6 (USNM); Chadron, 1 (NSM); Crawford, 2 (1 HM, 1 RV). DIXON COUNTY: Ponca, 1 (NSM). GARDEN COUNTY: Lewellen, 1 (NSM). MERRICK COUNTY: near Silver Creek, 1 (RV). SIOUX COUNTY: Squaw Canyon, N of Harrison, 1 (NSM); Toadstool Park, near Orella, 1; Harrison, 1 (NSM); *4 mi. W Crawford*, 1 (NSM); SW corner, N of Mitchell, 1 (NSM). THOMAS COUNTY: near Halsey, 1.

Additional records (Swenk, MS, unless otherwise noted): ANTELOPE COUNTY: N of Antelope Creek, near [W of] Neligh (Cary, MS). BOYD COUNTY: no specific locality (Fichter, 1944:18). BOX BUTTE COUNTY: no specific locality (Fichter, 1944:18). BUFFALO COUNTY: Gibbon (Cary, MS); near Kearney. CUMING COUNTY: West Point. DODGE COUNTY: Fremont. FRANKLIN COUNTY: Lost Creek. HOLT COUNTY: no specific locality (Fichter, 1944:18). KEYA PAHA COUNTY: no specific locality (Fichter, 1944:18). KNOX COUNTY: no specific locality (Fichter, 1944:18). LINCOLN COUNTY: 20 mi.

S North Platte. MADISON COUNTY: Elkhorn Valley (Cary, MS). ROCK COUNTY: no specific locality (Fichter, 1944:18). SCOTTS BLUFF COUNTY: 12 mi. NW Bayard; S of Gering. SHERIDAN COUNTY: Gordon. WASHINGTON COUNTY: S of Blair (Velich, 1958:148); Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:369); *between Ft. Calhoun and Omaha* (Velich, 1958:148).

TABLE 22.—CRANIAL MEASUREMENTS OF LYNX RUFUS RUFUS.

Number of specimens averaged or catalogue number, and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Palatal length	Length of nasals	Length of maxillary tooth-row
Dawes and Sioux counties						
Average 6 (♂)	118.7	91.2	25.8	51.3	32.7[5]	39.6
Minimum	115.9	87.7	24.2	50.1	31.6	38.0
Maximum	120.6	93.4	27.9	53.6	34.5	41.2
30 NSM, ♀	107.0	80.4	24.0	44.9	29.6	35.7
4426 NSM, ♀	109.7	85.7	21.6	46.5	28.7	37.6
Brown and Cherry counties						
164720 AMNH, ♂	112.5	85.9	25.4	47.8	32.7	38.2
164721 AMNH, ♂	119.2	90.7	26.0	51.4	32.9	39.0
15412 Dickey, ♂	120.6	88.6	23.7	50.6	31.7	41.1
12631 NSM, ♀	114.4	89.4	23.1	49.6	31.1	37.9
near Silver Creek, Merrick County						
RV, ♂	120.5	.....	27.1	49.9	33.6	40.1

Order ARTIODACTYLA—Even-toed Ungulates

Six species of artiodactyls, representing three families, are native to Nebraska; a seventh species, the fallow deer of the Old World, has been introduced. At least two, probably three, of the native species were extirpated within the borders of the state by the white man.

Because ungulates are conspicuous animals, and because they were sought for food by the early explorers, travelers, and settlers, many references to them are found in the historical literature dealing with Nebraska. Only those references of particular note are cited in the accounts beyond. All available information has been taken into account, nevertheless, in determining the distribution and relative abundance of the several species. The same holds true for much of the recent processed literature relating to the conservation and management of the three present-day game species—the two kinds of deer and the pronghorn.

Key to Nebraskan Artiodactyls

1. Frontal appendages (horns) not deciduous, present in both sexes; lacrimal bone articulating with nasal bone (family Bovidae).....2
1′. Frontal appendages (horns or antlers) deciduous, absent in females (except Antilocapridae); lacrimal bone not articulating with nasal bone.....3
2(1). Frontal appendages curved outward and upward; tail more than 225; maxillary tooth-row more than 110.....*Bison bison*, p. 324
2′. Frontal appendages curved backward and downward; tail less than 225; maxillary tooth-row less than 110.....*Ovis canadensis*, p. 328
3(1′). Frontal appendages (horns) composed of fused hairs surrounding bony core, present in both sexes; lateral digits ("dew hoofs") absent (family Antilocapridae).....*Antilocapra americana*, p. 321
3′. Frontal appendages (antlers) composed of bone, absent in females; lateral digits present (family Cervidae).....4
4(3′). Tail straw-colored; maxillary tooth-row more than 110; knoblike canine at junction of maxilla and premaxilla....*Cervus canadensis*, p. 308
4′. Tail bicolored (white along with brown or black); maxillary tooth-row less than 110; canine lacking.....5
5(4′). Antlers palmate distally; premaxillae not meeting anteriorly; posterior nares incompletely divided by vomer.....*Dama dama*, p. 336
5′. Antlers not palmate; premaxillae meeting anteriorly, or nearly so; posterior nares divided by vomer.....6
6(5′). Tail brown above, white below; length of metatarsal gland approximately 30; each antler having one main beam that gives rise to a series of tines; lacrimal pit shallow.....*Odocoileus virginianus*, p. 315
6′. Tail whitish, tipped with black; length of metatarsal gland 50 or more; each antler having main beam distinctly forked, thus forming two secondary branches, each of which bears tines; lacrimal pit deep. *Odocoileus hemionus*, p. 311

Family Cervidae—Wapiti, Deer and Allies

Cervus canadensis

Wapiti

The wapiti, or American elk, formerly occurred throughout Nebraska but was extirpated by man. The last wild individuals were killed in the early 1880's.

According to Swenk (1908:71) the species was "abundant equally in the thinly wooded Missouri region, the open Sandhills, and the rugged Pine Ridge and Bad Lands." Cary (MS) reported it "especially abundant in the western part, where immense herds roamed as late as 1870," and Aughey (1880:118) wrote of the "magnificent herds" seen along the Niobrara and Elkhorn rivers in 1866 and 1867. Perusal of many accounts of the early exploration and settlement of Nebraska suggests to me that the wapiti was more abundant in the eastern part of the state, possibly owing to the more abundant food supply, better cover, and less competition from other native ungulates, especially the bison.

Historical accounts are commonplace that record bands numbering in the hundreds and indicate that the species was yet common in some places in the state as late as the early 1870's. The last large herd to be reported was one containing 84 individuals seen in eastern Wheeler County in December, 1877 (Cary, MS); on January 22 of the same year a band of 60 was seen "within a mile and a half of Sidney" (Swenk, MS).

The total number of wapiti in Nebraska today, all probably descendent from animals reintroduced into the state, and all on public or private reservations, approximates 200.

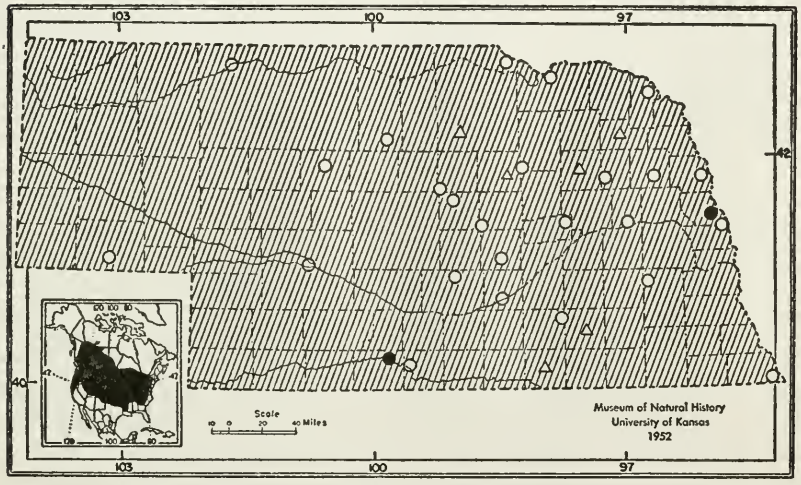

FIG. 72. Former distribution of *Cervus canadensis canadensis* in Nebraska. For explanation of symbols see Fig. 5.

Cervus canadensis canadensis Erxleben

[Cervus elaphus] canadensis Erxleben, Systema regni animalis . . ., p. 305, 1777 (type locality, eastern Canada, probably the vicinity of Montreal according to V. Bailey, Proc. Biol. Soc. Washington, 48:187, November 15, 1935).

Cervus canadensis, Borowski, Gemeinnüzzige Naturgeschichte des Thierreichs, 1(3):72, 1780; Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):638, July 14, 1858; Swenk, Proc. Nebraska Acad. Sci., 8:72, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:16, September, 1908; Jones, Bull. Univ. Nebraska State Mus., 4:95, November 26, 1962.

Cervus major, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823.

Cervus Canadensis, Aughey, Sketches of the physical geography and geology of Nebraska, p. 118, 1880.

Cervus canadensis canadensis, Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 407, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:17, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Butler, Jour. Mamm., 15:246, August 10, 1934; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Velich, Jour. Mamm., 42:92, February 20, 1961.

Cervus canadensis nelsoni, Swenk, Nebraska Bird Rev., 5:53, July 31, 1937.

C[ervus]. c[anadensis]. canadensis, Jones, Trans. Kansas Acad. Sci., 60:281, October 22, 1957.

Distribution in Nebraska.—Formerly state-wide; now extinct except on reservations where the species has been reintroduced. See Fig. 72.

Measurements.—No reliable external measurements of a Nebraska-taken specimen are available (Baird, 1858:643, cited measurements of a male from the "Republican Fork," but at least some are in error). Seton (1929, 3:6) listed measurements of a male and female, respectively, from Wyoming (probably of subspecies *C. c. nelsoni*) as follows: 2590, 2235; 140, 114; 635, 635. Murie (1951:71) recorded the average weight of mature males and females from western Wyoming as 631 lbs. and 520 lbs., respectively.

Respective cranial measurements of the male from "Republican Fork" [Furnas County] and a female from "Nebraska" are: condylobasal length, 463, 435; breadth across orbits, 195, 184; length of nasals, 176, 175; length of maxillary tooth-row, 141, 137; length of mandibular premolar-molar row, 156, 149.

Remarks.—Only one specimen that was shot in the flesh and that is from a precisely known locality in Nebraska is preserved. This individual, a male (USNM 2579), was obtained by members of Lt. F. T. Bryan's exploration party along the Republican River in what is now Furnas County on October 4, 1856.

Of interest is the report (in *litt.*, May 9, 1960) by John Mathisen, District Game Supervisor for the Nebraska Game, Forestation and Parks Commission, that a bull elk was observed several times in December, 1958, in the vicinity of Berea, Box Butte County. It is not known certainly that this individual was an escapee, although Mathisen reasoned that probably it was.

Records of occurrence.—Specimens examined, 5, as follows: CHERRY COUNTY: *Ft. Niobrara Nat'l Wildlife Refuge* (introduced), 1 (USNM). FURNAS COUNTY: "Republican Fork," 1 (USNM). WASHINGTON COUNTY: about 6 mi. S Blair, 1 (RV). County unknown: *"Nebraska,"* 2 (USNM).

Selected additional records (Jones, 1962:95-96, unless otherwise noted): ANTELOPE COUNTY: southwestern part, near head of Beaver Creek. BOYD COUNTY: Ponca Island. BROWN COUNTY: Calamus River. BUFFALO COUNTY: along South Loup River. BURT COUNTY: along Missouri River. CHERRY COUNTY: Niobrara River, S of Merriman. CHEYENNE COUNTY: within 1½ mi. Sidney (Swenk, MS). CLAY COUNTY: near Sutton. COLFAX COUNTY: near Schuyler (MVZ). CUMING COUNTY: along Elkhorn River, near West Point. DIXON COUNTY: along Missouri River, about 10 mi. below the mouth of Vermillion River. FILLMORE COUNTY: no specific locality. GARFIELD COUNTY: between North Loup and Calamus rivers. GREELEY COUNTY: southwestern part, south of North Loup River. HALL COUNTY: Grand Isle. HARLAN COUNTY: near mouth of Spring Creek. HOLT COUNTY: southwestern part. HOWARD COUNTY: along Loup River, about opposite Oak Creek. KNOX COUNTY: near mouth of Bazile Creek. LANCASTER COUNTY: northwestern part, along Oak Creek. LINCOLN COUNTY: near fork of Platte River (James, 1823:463). MADISON COUNTY: no specific locality. NANCE COUNTY: eastern part, near Beaver Creek. NUCKOLLS COUNTY: no specific locality. RICHARDSON COUNTY:

4 mi. SE Rulo (Hill and Wedel, 1936:64, archeological site). STANTON COUNTY: 6 mi. E Madison (Swenk, 1908:71). THOMAS COUNTY: along Middle Loup River, about 5 mi. E Thedford. VALLEY COUNTY: near Elyria; *Hascall Creek*. WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:370). WAYNE COUNTY: no specific locality. WHEELER COUNTY: eastern part.

Odocoileus hemionus

Mule Deer

The present-day distribution of the mule deer in Nebraska closely approximates the distribution of the species when the white man first settled the area; in fact, its distribution may extend somewhat farther to the southeast now than formerly although the species still does not occur in the southeastern part of the state. The remains of mule deer reported by Hill and Wedel (1936:64) from an archeological site 4 mi. SE Rulo (in the extreme southeastern corner of Nebraska) may have been incorrectly identified, or, if properly identified, probably were transported to the site from a more westerly locality by the early inhabitants.

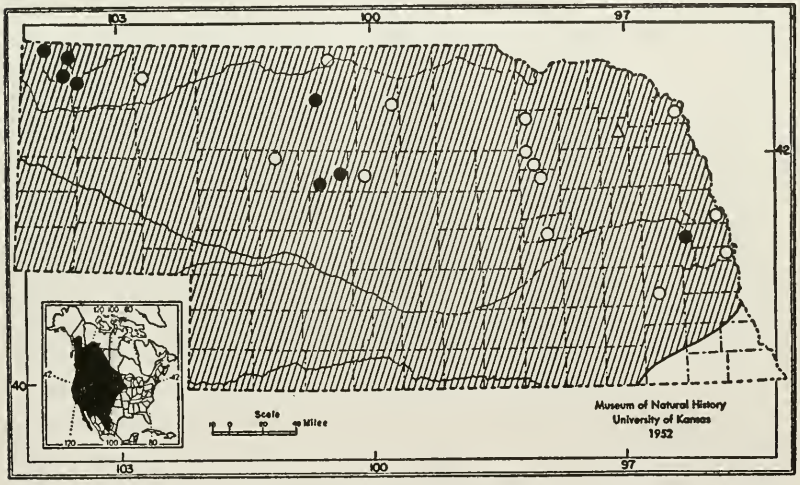

FIG. 73. Distribution of *Odocoileus hemionus hemionus* in Nebraska. For explanation of symbols see Fig. 5.

The deciduous riparian association along the Missouri River and perhaps the river itself constitute at least a partial barrier to eastward dispersal of *O. hemionus*. Early travelers up the Missouri did not observe mule deer along the river until near what is now the South Dakota-Nebraska boundary. Lewis and Clark, for example, reported (Thwaites, 1905:122) that the species was "met with as

low [on the Missouri] as the antient [sic] fortification [near the mouth of the Niobrara] & on Boon homm [= Bonhomme] Island . . .," and Hayden (1863:149) noted that it was not seen below the mouth of the Niobrara. The most southerly reports along the Missouri prior to the turn of the last century were those of an individual killed on Logan Creek, near Dakota City, in 1871 (Swenk, 1908:73) and of another seen by J. J. Audubon in 1843 in what is now northeastern Burt County (Audubon and Coues, 1898:484). Recently the species has been reported along the Missouri from as far south as Washington and Sarpy counties (Velich, 1961:94) and from the Iowa side as far south as Fremont County (Kline, 1959:148), but it is rare along the river below the vicinity of the mouth of the Niobrara.

Deer of both species were an important source of food for early travelers and settlers in Nebraska and judging from historical accounts, were common in most areas until about 1880. Due to increasing pressure from hunting, however, the deer population steadily declined. Cary (MS, about 1905) reported that the range of the mule deer was "restricted to the roughest breaks of the Pine Ridge, in Sioux County, if, indeed, any still exist within our confines." Swenk (1908:73) wrote of *O. hemionus* as follows: "Although formerly a very common animal all over the state, the black-tailed deer is almost extinct within our borders. In the Pine Ridge, where the white-tailed [deer] still persists, *hemionus* has practically disappeared, although ten or fifteen years ago it was frequently seen and killed among the rough canyon heads."

Alarmed at the prospects of extirpation of deer in Nebraska the State Legislature in 1907 afforded both species complete protection —protection that was to continue in all but a fraction of the state for more than 40 years. Even though protected deer were rare in Nebraska for several decades. Bailey *et al.* (1957:9) wrote as follows: "The recovery of our deer population from the extremely low numbers in the early 1900's was very slow. As late as 1919 some authorities thought that deer were doomed to extinction in Nebraska. But by the late 1930's, deer had increased to the point where their presence was known at various points in the state. Game Commission surveys in the winter of 1939-1940 found between 2,000 and 3,000 deer, mostly of the mule species, in the Pine Ridge section and a few in the Platte and Niobrara River valleys and in other areas. Deer have been observed recently in every county in the state. Game Commission surveys in the fall of 1955 and the spring of 1956 indicated the approximate populations in the panhandle alone at

45,000 deer." Insofar as I know the recovery of mule deer populations in Nebraska resulted from increase and dispersal of native stock and not from introductions.

TABLE 23.—SOME STATISTICS RELATING TO DEER HUNTING IN NEBRASKA, 1945-1960.

Year	Number of permits authorized	Number of permits issued	Approximate per cent state open to hunting	Number of deer taken
1945.....	500	500	0.2	361
1949.....	1,500	1,500	8.5	910
1950.....	1,000	1,000	8.5	680
1951.....	1,200	1,200	8.2	712
1952.....	2,500	2,500	11.5	1,921
1953.....	5,300	5,300	40.6	4,083
1954.....	4,000	4,000	36.8	2,753
1955*.....	6,750	5,597	35.0	4,300*
1956*.....	9,650	8,200	47.1	6,561*
1957*.....	16,400	12,174	49.7	8,450*
1958*.....	10,000	9,580	62.8	5,789*
1959*.....	11,850	11,044	79.5	6,322*
1960*.....	14,000	12,596	91.1	5,399*

* Does not include take by archers in the years indicated, which was as follows: 1955, 7; 1956, 28; 1957, 80; 1958, 221; 1959, 223; 1960, 221. An archery season first was authorized in 1955. All figures courtesy Nebraska Game, Forestation and Parks Commission.

The first open season for deer in the state after 1906 was in December, 1945, when 500 permits were granted for a 21-day season within the confines of the Halsey Division of Nebraska National Forest. A total of 361 deer were harvested, 359 of which were mule deer (see Mohler *et al.*, 1951, for details of the 1945 hunt). From 1946 through 1948 no season was authorized for deer but a season has been opened in each year since 1949. The results of deer seasons in recent years are summarized in Table 23.

The mule deer breeds in Nebraska from October through December and females bear 1 or 2 (exceptionally 3) young, usually in June or early July. A female from Thomas County taken on March 18, 1946, carried twin embryos of opposite sex.

Odocoileus hemionus hemionus (Rafinesque)

Cervus hemionus Rafinesque, Amer. Monthly Mag., 1:436, October, 1817 (type locality, mouth of Big Sioux River, Union Co., South Dakota).

Odocoileus hemionus, Merriam, Proc. Biol. Soc. Washington, 12:100, April 30, 1898; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:74, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:18, September, 1908.

C[ervus]. macrotis, Aughey, Sketches of the physical geography and geology of Nebraska, p. 118, 1880 (part).

C[ervus]. columbianus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 118, 1880 (part).

Odocoileus hemionus hemionus, Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:17, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Mohler, Wampole and Fichter, Jour. Wildlife Mgt., 15:129, April, 1951; Cowan, *in* The deer of North America . . ., p. 342, 1956; Velich, Jour. Mamm., 42:94, February 20, 1961.

O[docoileus]. h[emionus]. hemionus, Jones, Trans. Kansas Acad. Sci., 60: 281, October 22, 1957.

Distribution in Nebraska.—State-wide except southeastern part; commonest in western two-thirds of state. See Fig. 73.

External measurements.—No external measurements of fully adult Nebraskan specimens are available. Respective measurements of two males, each a year old, and a female two years old from Sioux County are: 1522, 1529, 1620; 180, 170, 191; 458, 462, 460; 206, 202, 205; weight, 115, 99, and 132 lbs. For cranial measurements see Table 24.

As adults, males average considerably larger than females. The average total length listed by Cowan (1956:345) for adult males was 1778 and for adult females was 1626. Fully adult males weigh on the average about 200 lbs. (although occasional individuals are recorded as weighing more than 400 lbs.) whereas adult females average only about 130 lbs.

Records of occurrence.—Specimens examined, 22, as follows: CHERRY COUNTY: 6 mi. NNW Kennedy, 1. DAWES COUNTY: 6 mi. S Crawford, 2; *7 mi. S, 3¾ mi. W Crawford*, 1 (NSM); *area E of Hgy. 2, W of Hgy. 385, S of Hgy. 20, N of Niobrara River*, 1; *no specific locality*, 1 (NSM). SAUNDERS COUNTY: Platte River, 1. SIOUX COUNTY: 1 mi. W Montrose, 1 (NSM); Orella, 1 (NSM); 1 mi. N, 10 mi. W Crawford, 1; *8 mi. W Crawford*, 1 (NSM); *4 mi. W Crawford*, 1 (NSM); *1 mi. W Ft. Robinson*, 1 (NSM). THOMAS COUNTY: 4 mi. S, 2 mi. W Halsey, 1; *near Halsey*, 1; *Nebraska Nat'l Forest*, 6 (5 NSM); Dismal River, S of Thedford, 1 (NSM).

Selected additional records (Mohler *et al.*, 1951:131, unless otherwise noted): ANTELOPE COUNTY: "rough lands of the Verdigris [Creek]," NW part of county; sandhills S of Clearwater Creek (Cary, MS); *Lincoln Twp.;* Logan Twp. BLAINE COUNTY: between Brewster and Dunning (Cary, MS). BOONE COUNTY: "extreme northern" part. BROWN COUNTY: near Long Pine. CHERRY COUNTY: near Valentine. DAKOTA COUNTY: Logan Creek, near Dakota City. HOOKER COUNTY: near Mullen (Swenk, 1908:73). LANCASTER COUNTY: near Lincoln (Hill and Cooper, 1937:245, archeological site). NANCE COUNTY: South Branch of Timber Creek, near Fullerton. RICHARDSON COUNTY: *4 mi. SE Rulo* (Hill and Wedel, 1936:64, archeological site). SARPY COUNTY: *Big Pipe Springs, Fontanelle Forest* (Velich, 1961:94); about 3 mi. S Bellevue (Velich, 1961:94). SHERIDAN COUNTY: near Hay Springs. THOMAS COUNTY: *1¾ mi. E Natick* (record on file, NGFPC). WASHINGTON COUNTY: De Soto Bend Wildlife Refuge (Velich, 1961:94). WAYNE COUNTY: no specific locality (Cary, MS).

Odocoileus virginianus

White-tailed Deer

Probably the white-tailed deer occurs in every county in Nebraska but it is outnumbered in much of the western part of the state by the mule deer. *O. virginianus* is characteristically an inhabitant of wooded and semi-wooded areas on the Great Plains and is thereby more or less limited in western Nebraska to the deciduous riparian communities along water courses.

The white-tail evidently was common in Nebraska when white men first reached the state. It was, in fact, mentioned more often in historical accounts than the mule deer because most early-day travel was along river courses where the white-tail was the commoner of the two species, or the only species, present. In most accounts *virginianus* was referred to simply as "deer," probably because it was the species that travelers from the eastern United States were accustomed to seeing; occasionally it was recorded as the "fallow deer" or the "red deer."

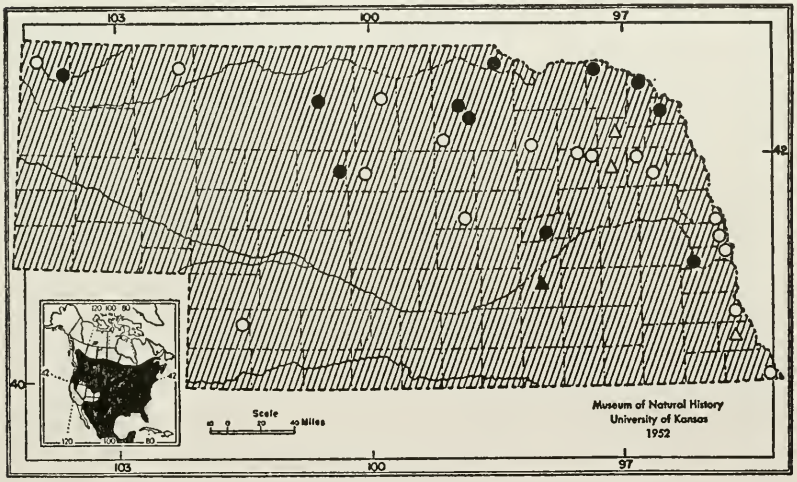

FIG. 74. Distribution of *Odocoileus virginianus macrourus* in Nebraska. For explanation of symbols see Fig. 5.

As in the case of the mule deer, numbers dropped to a critical low around 1900. Cary (MS) wrote of the species: "This deer formerly ranged abundantly over the entire state, but is now confined principally to the Pine Ridge country, where it is still occasionally met with in the heavily timbered canyons of Dawes and Sioux counties. A

few remain along the Niobrara River . . . as well as in the roughest breaks and canyons of the Sand Hills. . . . The species is now practically extinct in the state east of the one-hundredth meridian." Swenk (1908:72-73) further observed: "In the early days the white-tailed deer was fairly common in the wooded portions of the state, especially along the river bottoms, and occasionally on the adjacent prairies also. It was most often met with along the northern border of the state, in the Niobrara valley, and in fact has only lately disappeared from that region, for within comparatively recent years it was common as far east as Norfolk. At present it is confined in this state to the Pine Ridge country, where it is becoming rarer year by year, though still occasionally seen." Cary's account indicated that in eastern Nebraska numbers declined rapidly after the severe winter of 1880.

In Nebraska the white-tailed deer seemingly did not increase in numbers so rapidly as did the mule deer from the "population low" that occurred near the turn of the century, but in recent years the increase has been proportionally greater than that of the latter. The state-wide ratio of white-tailed deer to mule deer killed in the 1960 hunting season was 35:100 as compared with only 6.3:100 in 1958. Most of this increase, it is true, resulted from the opening of new hunting areas in eastern Nebraska in which white-tails far outnumber mule deer, but at the same time significant increases

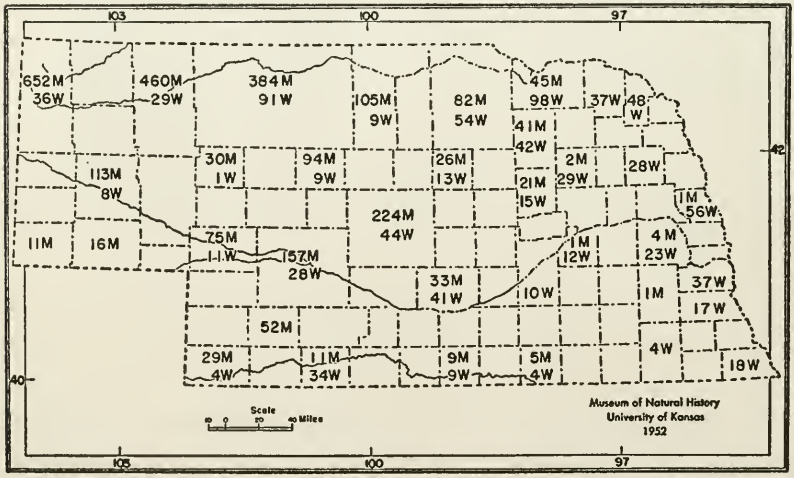

FIG. 75. Actual numbers of mule deer (M) and white-tailed deer (W) taken in representative Nebraskan counties in the 1960 hunting season. Figures for Sheridan and Sioux counties include deer from small parts of adjoining Box Butte and Dawes counties. All figures courtesy Nebraska Game, Forestation and Parks Commission.

were recorded in areas of western Nebraska that have been open to hunting for several years. In the Pine Ridge Management Unit, for example, the 1960 ratio was 6.5:100 as compared with 3.3:100 in 1958 and in the Upper Platte Management Unit the ratio was 5.3:100 as compared with 0.8:100 (same years). The actual numbers of the two species taken in the 1960 hunting season is shown for selected counties in Figure 75.

I know of no introductions of white-tailed deer into Nebraska from other areas within the range of the species and assume that repopulation of the state has resulted mostly from increase and spread of native stock from Nebraska and adjoining states. I do know that the Nebraska Game, Forestation and Parks Commission has transplanted deer from the northeastern part of the state to the southeastern part in the past several years.

Structural differences between *O. virginianus* and *O. hemionus* in Nebraska and adjoining regions are great. Externally, aside from the marked differences in length, shape, and color of tail, and between the antlers of males, *virginianus* usually is more reddish brown, has smaller ears (less than 180 mm. from notch in adults as opposed to more than 190), a much smaller preorbital gland, a smaller metatarsal gland (usually less than 30 mm. long as opposed to 50 or more), and a larger, more conspicuous pad and tuft of hairs adjacent to (inside) the heel. Cranially, *virginianus* has markedly smaller lacrimal pits, larger bullae, smaller incisors, a narrower skull throughout relative to length (see measurements), and the palatines extend much farther posteriorly beyond the last molars and are V-shaped at the posterior margin (rather than U-shaped, or broadly emarginate on either side of the midline).

The generic name *Dama* has been applied to the large American deer by several authorities since Hershkovitz (1948) showed it to have 52 years priority over the long-used *Odocoileus*. However, Opinion 581 of the International Commission on Zoological Nomenclature (Bull. Zool. Nomenclature, 17:267-275, September 16, 1960) validated *Odocoileus* Rafinesque, 1832, with type species *O. speleus* Rafinesque, 1832 [= *Dama virginiana* Zimmermann, 1780] as the generic name for these deer.

Like the mule deer the white-tail breeds in early winter. Females bear 1-4 (usually 2, rarely 4) young from late May to early July after a gestation period of about six and a half months. Of seven pregnant females from eastern Nebraska of which I have record, three carried a single embryo, three carried twins, and the seventh carried triplets.

Odocoileus virginianus macrourus (Rafinesque)

Corvus [sic] macrourus Rafinesque, Amer. Monthly Mag., 1:436, October, 1817 (type locality, "Plains of the Kangar [= Kansas] River;" restricted to plains near Wakarusa Creek, Douglas Co., Kansas, by Miller and Kellogg, Bull. U. S. Nat. Mus., 205:804, March 3, 1955).

Odocoileus virginianus macrourus, Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Swenk, Proc. Nebraska Acad. Sci., 8:73, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:17, September, 1908; Swenk, Nebraska Bird Rev., 5:53, July 31, 1937.

Cervus Virginianus, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:103, 370, 1823; Aughey, Sketches of the physical geography and geology of Nebraska, p. 118, 1880 (part).

Cervus leucurus, Baird, Mammals, *in* Reports of explorations and surveys . . . from the Mississippi River to the Pacific Ocean . . ., 8(1):649, July 14, 1858.

C[ervus]. leucrus [sic], Aughey, Sketches of the physical geography and geology of Nebraska, p. 118, 1880 (part).

Odocoileus americanus macrourus, Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:17, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920.

O[docoileus]. v[irginianus]. macrourus, Jones, Trans. Kansas Acad. Sci., 60:281, October 22, 1957 (*O. v. dacotensis* and *O. v. texanus* also mentioned as possibly occurring in Nebraska).

Distribution in Nebraska.—State-wide in suitable habitat. See Fig. 74.

External measurements.—No measurements are available of recently taken Nebraskan specimens. James (1823:103) recorded in inches (here converted to mm.) the measurements of an animal of unknown sex taken in February, 1820 at Long's winter quarters in Washington County, as follows: 1645; 241 ("from lateral base"); 464; weight, 115 lbs. Baird (1858:653) recorded (in inches) a female taken on October 9, 1856, on the "Republican Fork" as measuring 1778 in total length and 280 in length of tail, but these measurements may have been taken from the skin of the animal rather than in the flesh. Kellogg (1956:44) listed the measurements of the largest male of the subspecies examined by him as: 1820; 240; 450. For cranial measurements see Table 24.

Mohler *et al.* (1951:147) recorded the hog-dressed weight of a female from Thomas County that was two and a half years old at 109 lbs. and that of a female three and a half years old from the same place as 134½ lbs. Schwartz and Schwartz (1959:321) recorded the weight of the largest male known from Missouri as 369 lbs.

Remarks.—No revisionary study of the species *O. virginianus* has ever been made and, excepting Kellogg's (1956) general remarks concerning characters, usable diagnoses for most of the earlier-named of the 30 currently recognized subspecies are lacking in the literature. By consequence, the biologist who attempts to identify specimens of the white-tailed deer from certain parts of North America to subspecies experiences considerable difficulty. Such is the case when specimens from Nebraska are considered.

I tentatively refer all white-tailed deer from Nebraska to the subspecies *O. v. macrourus* because I find no cranial features that distinguish the available specimens from specimens of *macrourus* from the vicinity of the type locality in northeastern Kansas. Earlier (1957:281) I suggested that three different subspecies might be

found to occur in Nebraska (see also Kellogg, 1956:35). The two in addition to *macrourus* were *O. v. dacotensis* Goldman and Kellogg, 1940, with type locality on the White Earth River, Mountrail County, North Dakota, and *O. v. texanus* (Mearns, 1898), with type locality at Fort Clark, Kinney County, Texas.

If *O. v. texanus* occurs at all in Nebraska it will be found in the southwestern part of the state. No specimens have been examined from this area but the few individuals that I have observed along the Republican River in the southwest were not suggestive of the small size and grayish color (as compared with *macrourus*) of *texanus*. Furthermore, the physiography of the region suggests that white-tails occurring there would likely show relationship to the population inhabiting the Republican drainage and other areas to the east rather than to the population occurring to the southwest.

The subspecific name *dacotensis* currently is applied to the white-tailed deer that inhabit the northern part of the Great Plains. The subspecies was characterized by its describers (1940:82) as: "Size very large, equaling or exceeding *Odocoileus virginianus macrourus* of eastern Kansas . . .; antlers heavy, moderately spreading, with tines relatively short; color . . . paler than usual in *macrourus* or *borealis;* dentition heavier than in any other member of the *virginianus* group." Later, Kellogg (1956:44) contrasted *macrourus* with *dacotensis* as follows: "Similar to *dacotensis* of North Dakota, but averaging somewhat smaller; cheek tooth series averaging shorter; and color somewhat darker." All in all, the alleged differences between the two subspecies do not appear to be great.

Unfortunately, none of the available specimens from Nebraska nor those from the vicinity of the type locality in northeastern Kansas is represented by a skin or even by complete external measurements and comparisons in external features, therefore, are impossible. Inasmuch as no cranial distinctions are apparent when Nebraskan specimens are compared with those from Kansas, the name *macrourus* is here applied to white-tails throughout Nebraska. I recognize, however, that deer from the northern and western parts of the state (especially in the Niobrara drainage and in the Pine Ridge, and possibly along the western reaches of the Platte) may be found best referable to *dacotensis* when more abundant materials are available for study.

Records of occurrence.—Specimens examined, 13, as follows: BOYD COUNTY: 3 mi. E Bristow, 1 (NSM). CEDAR COUNTY: 1 mi. S, 3½ mi. W St. Helena, 1 (NSM). CHERRY COUNTY: Valentine Nat'l Wildlife Refuge, 1. DAKOTA COUNTY: Hubbard, 1 (NSM). DIXON COUNTY: 9 mi. NW Ponca, 1. HAMILTON COUNTY: no specific locality, 1 (HM). HOLT COUNTY: 6 mi. S, 1 mi. E Atkinson, 1 (NSM); 9 mi. S Emmet, 1 (NSM). NANCE COUNTY: Loup

River at Fullerton, 1 (NSM). SARPY COUNTY: Linoma Beach, 1 (RV). SAUNDERS COUNTY: *5 mi. NE Ashland*, 1 (NSM). SIOUX COUNTY: *½ mi. W Ft. Robinson*, 1; 8 mi. W Crawford, 1. THOMAS COUNTY: near Halsey, 1.

Selected additional records (Swenk, MS, unless otherwise noted): ANTELOPE COUNTY: 5 mi. W Neligh (Cary, MS). BLAINE COUNTY: between Brewster and Dunning (Cary, MS). BROWN COUNTY: Ainsworth (Cary, MS). CHASE COUNTY: 12 mi. N Wauneta (Hill and Metcalf, 1942:204, archeological site). CUMING COUNTY: Wisner; *2 mi. E Beemer* (Cary, MS); West Point. DOUGLAS COUNTY: Omaha (record on file, NGFPC). HOLT COUNTY: southwestern part. MADISON COUNTY: N of Battle Creek (Cary, MS); Norfolk (Swenk, 1908:73). NEMAHA COUNTY: no specific locality (record on file, NGFPC). OTOE COUNTY: "Missouri River, below Nebraska City." RICHARDSON COUNTY: 4 mi. SE Rulo (Hill and Wedel, 1936:63, archeological site). SARPY COUNTY: Child's Point. SHERIDAN COUNTY: Gordon. SIOUX COUNTY: Warbonnet and *Jim Creek* canyons (Swenk, 1908:73). STANTON COUNTY: no specific locality. VALLEY COUNTY: ¾ mi. N, 6 mi. W North Loup (Hill and Kivett, 1941:183, archeological site). WASHINGTON COUNTY: *De Soto Bend Wildlife Refuge* (Velich, 1961:94); *Ft. Calhoun; Rockport;* Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:370). WAYNE COUNTY: no specific locality. County unknown (Baird, 1858:653): *Platte River; Republican Fork.*

TABLE 24.—CRANIAL MEASUREMENTS OF TWO SPECIES OF ODOCOILEUS.

Catalogue number and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Length of nasals	Length of maxillary tooth-row	Length of mandibular premolar-molar row
Odocoileus hemionus hemionus, Cherry County						
78601 KU, ♂	293.0	134.6	83.5	104.1	85.7	96.4
Sioux County						
12191 NSM, ♂	309.0	137.6	86.9	103.2	88.4	98.2
4452 NSM, ♀	274.5	120.7	73.5	99.2	85.1	96.0
4453 NSM, ♀	261.5	114.6	73.9	89.4	84.5	97.7
12192 NSM, ♀	283.5	128.7	85.9	88.2	78.9	87.8
Thomas County						
3267 NSM, ♂	283.0	141.5	83.1	100.3	80.9	87.8
4455 NSM, ♂	281.0	.....	.....	.....	80.7	89.4
3313 NSM, ♀	253.5	114.4	71.5	89.8	82.6	95.0
Odocoilcus virginianus macrourus, Saunders County						
146 NSM, ♂	281.0	117.4	69.9	96.4	79.0	84.5
Thomas County						
73490 KU, ♀	272.5	109.3	66.0	89.4	80.1	88.4
Dixon County						
79246 KU, ♀	278.0	111.9	59.6	92.8	77.0	83.1
Northeastern Kansas						
85413 KU, ♂	292.5	117.4	74.5	104.4	86.3	95.1
68314 KU, ♀	277.0	111.1	65.2	94.0	85.0	91.8
76502 KU, ♀	270.5	108.0	61.3	82.8	77.3	88.5

Family ANTILOCAPRIDAE—Pronghorn

Antilocapra americana

Pronghorn

The pronghorn, or "antelope" as it is so often mistakenly referred to in lay literature, is a characteristic plains inhabitant and was abundant on the open grasslands of Nebraska in historic times. Its eastern distribution apparently was sharply limited by the forested areas bordering the Missouri River and its range did not reach the Missouri in Nebraska except in the vicinity of the Nebraska-South Dakota border (early travelers up the river did not observe the pronghorn below the mouth of the Niobrara). There, and especially northward in South Dakota, the deciduous riparian community bordering the river thinned—even became discontinuous in some sections—and evidently ceased to be a barrier to eastward dispersal (see Jones, 1960*a*:249).

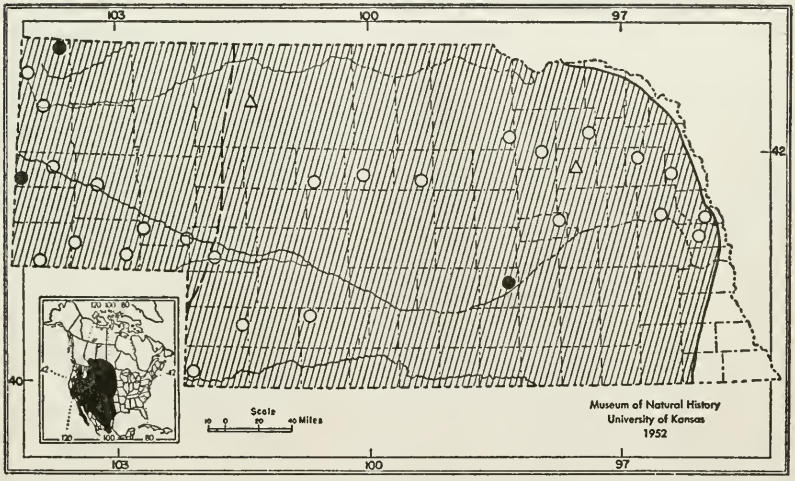

FIG. 76. Distribution of *Antilocapra americana americana* in Nebraska. For explanation of symbols see Fig. 5. Dashed line indicates approximate eastern limit of present distribution excepting recent introductions.

Antilocapra americana was extirpated in eastern Nebraska by about 1875 and by 1900 the species was reduced in the state to a few isolated bands in the Sand Hills and Panhandle. Swenk (1908:74-75) wrote of the pronghorn as follows: "Originally abundant over the entire state, but now almost extinct within our borders. . . . At the present time the antelope is confined to the region

west of the 101st meridian and is very rare throughout this territory except in the Pine Ridge country, where it is yet occasional on the plateaus and about the canyon heads and divides. . . . Its complete disappearance is the matter of only a very few more years."

Nelson (1925) in his review of the status of the pronghorn recorded 10 small bands with an estimated total of approximately 187 individuals as resident in the state. Nelson's estimate should be adjusted, however, to exclude the band of 10 introduced from Nevada in 1924 on the Ft. Niobrara National Wildlife Refuge and two bands (about 10 mi. W Bushnell and about 18 mi. S Sidney) totaling 45 individuals that by his figures were located in neighboring states, albeit near the Nebraska border. Nelson (p. 37) commented that: "The occupation of Nebraska for farming purposes is so complete that there is little hope of a herd being maintained there except under fence. Safe free range for antelope in this State is a thing of the past." Contrary to the pessimistic predictions by Swenk and Nelson, the species, which was accorded full protection in 1907, never became extinct in Nebraska.

The pronghorn evidently did not survive on the Sand Hills; populations in the Panhandle, however, recovered slowly but steadily and by the late 1930's the species was numerous enough in some places that individuals caused real damage to stored hay (Swenk, MS). Numbers continued to increase through the 1940's and the species spread into suitable areas throughout the Panhandle and

TABLE 25.—SOME STATISTICS RELATING TO HUNTING OF PRONGHORNS IN NEBRASKA, 1953-1960.

Year	Number of permits authorized	Number of permits granted	Pronghorns taken
1953	150	150	133
1954	500	500	421
1955	1,000	923	796
1956	1,000	897	748
1957	1,450	1,058	783
1958		No season	
1959	250	250	219
1960	550	550	422

Figures courtesy Nebraska Game, Forestation and Parks Commission.

reoccupied the western edge of the Sand Hills. In 1953, for the first time since 1906, a hunting season was opened in limited areas of the Panhandle and a season has been open in each subsequent year except 1958 (see Table 25). Generally sound management practices, coupled with an increasing awareness on the part of the public of the asthetic, recreational, and monetary value of large game animals, have insured the future of pronghorn and deer in Nebraska.

Aside from increase and dispersal of animals within the state, individuals have been introduced on several occasions from places outside Nebraska but always from within the range of the subspecies *A. a. americana*. In 1958, 1959, and 1960, the Nebraska Game, Forestation and Parks Commission, with the co-operation of local landowners, released more than 1000 pronghorns at some 20 different locations in the eastern and central parts of the Sand Hills, seeking to reestablish the species there. While it is yet (1962) too early to forecast the results of these releases, initial reports are optimistic. Most of the animals transplanted came from the Panhandle but at least those released at one site, along with a herd of 27 released on the Sioux Ordinance Depot in Cheyenne County, came from Colorado.

Young are born in late May and June after a gestation period of approximately eight months. Females usually bear twins; Hoover *et al.* (1959:25) recorded that 39 of 42 (93 per cent) pregnant females examined in Colorado carried two embryos. My field notes reveal one observation of a female with a single kid and two observations of does with twins, all in Sioux County.

Antilocapra americana americana (Ord)

Antilope Americanus Ord, *in* Guthrie, A new geographical, historical, and commercial grammar . . ., ed. 2, 2:292, 308, 1815 (type locality, unknown; noted in the original description as found "on the plains and the high-lands of the Missouri").

Antilocapra americana, Ord, Jour. Phys. Chim. Hist. Nat. et Arts, 87:149, 1818; Cary, Proc. Nebraska Ornith. Union, 3:69, December, 1902; Elliot, Field Columb. Mus., Publ. 115 (Zool. Ser.), 8:53, 1907; Swenk, Proc. Nebraska Acad. Sci., 8:75, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:19, September, 1908; Nelson, Bull. U. S. D. A., 1346:1 (see pp. 37-38), August, 1925.

Antilocapra Americana, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823 (*Cervicapra americana* used also on p. 348); Aughey, Sketches of the physical geography and geology of Nebraska, p. 118, 1880.

Antilocapra americana americana, Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:17, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Swenk, Nebraska Bird Rev., 5:54, July 31, 1937.

A[ntilocapra]. a[mericana]. americana, Jones, Trans. Kansas Acad. Sci., 60: 281, October 22, 1957.

Distribution in Nebraska.—Formerly state-wide except eastern edge; presently confined mostly to Panhandle, excepting recent reintroductions on the Sand Hills. See Fig. 76.

Measurements.—External and cranial measurements of an adult male from 7 mi. NW Orella are: 1428; 95; 431; 149; weight, 134 lbs.; condylobasal length, 266.0; zygomatic breadth, 135.5; interorbital constriction, 115.3; length of nasals, 114.6; length of maxillary tooth-row, 74.7; length of mandibular premolar-molar row, 71.2. Females average somewhat smaller than males.

Remarks.—James' (1823:370) report of *A. americana* from Major Long's winter quarters on the Missouri River (Engineer Cantonment) is inconsistent with my claim that the species did not occur along the Missouri at that latitude. In previous text, however, it is obvious that James was referring to individuals taken to the west of the Cantonment between the Missouri and the Elkhorn. I doubt the validity of Grinnell's (1929:135) report (from a newspaper article) of a wild pronghorn seen near Louisville on December 28, 1921, and have not admitted the record in the list beyond.

Records of occurrence.—Specimens examined, 10, as follows: CHERRY COUNTY: *Ft. Niobrara Nat'l Wildlife Refuge* (introduced), 2 (1 NSM, 1 USNM). HALL COUNTY: Grand Island, 1 (NSM). SCOTTS BLUFF COUNTY: Signal Butte, 1 (USNM). SIOUX COUNTY: 7 mi. NW Orella, 2 (NSM). County unknown: *Platte River,* 3 (USNM); *western Nebraska,* 1 (NSM).

Selected additional records (Swenk, MS, unless otherwise noted): ANTELOPE COUNTY: S of Neligh (Cary, MS). BLAINE COUNTY: between Brewster and Dunning (Cary, MS). BURT COUNTY: "Logan Creek flats," W of Oakland. CHASE COUNTY: 12 mi. N Wauneta (Hill and Metcalf, 1942:204, archeological site). CHERRY COUNTY: S of Snake River (Cary, MS). CHEYENNE COUNTY (Nelson, 1925:38): between Dix and Potter; near Sunol. CUMING COUNTY: Plum Creek, E of Wisner. DODGE COUNTY: W of Fremont (Grinnell, 1929:135). DOUGLAS COUNTY: vicinity Elkhorn. DUNDY COUNTY: N of Haigler. FRONTIER COUNTY: W of Curtis. GARDEN COUNTY: 12 mi. S Lisco (Nelson, 1925:38); Ash Hollow, 3 mi. SE Lewellen (Champe, 1946:43, archeological site). HOLT COUNTY: Cache Creek, S of Ewing (Cary, MS). KEITH COUNTY: Ogallala (Swenk, 1908:75). KIMBALL COUNTY: near state line S of Kimball (Nelson, 1925:38). MADISON COUNTY: no specific locality. MORRILL COUNTY: North Platte River, N of Bridgeport (Nelson, 1925:37). NANCE COUNTY: vicinity Beaver Creek (James, 1823:348). LOUP COUNTY: about 15 mi. N Sargent (Nelson, 1925:38). PIERCE COUNTY: approximately 18 mi. N Norfolk (Cary, MS). SCOTTS BLUFF COUNTY: vicinity Scottsbluff (Grinnell, 1929:138). SIOUX COUNTY: state line W of Harrison (Swenk, 1908:75); near Agate (Nelson, 1925:38). THOMAS COUNTY: Dismal River, S of Thedford. WASHINGTON COUNTY: [west of] Engineer Cantonment (James, 1823:370).

Family BOVIDAE—Bovids

Bison bison

Bison

Prior to settlement of Nebraska by the white man the bison was state-wide in distribution and seemingly as abundant as in any other area of equivalent size. Accounts in the historical literature

attesting to the occurrence and abundance of the species are legion and only one such is quoted here by way of example. On June 22, 1820, just west of the place where the Platte River forks in what is now Lincoln County, members of Major S. H. Long's command observed bison as recorded by James (1823:466-467):

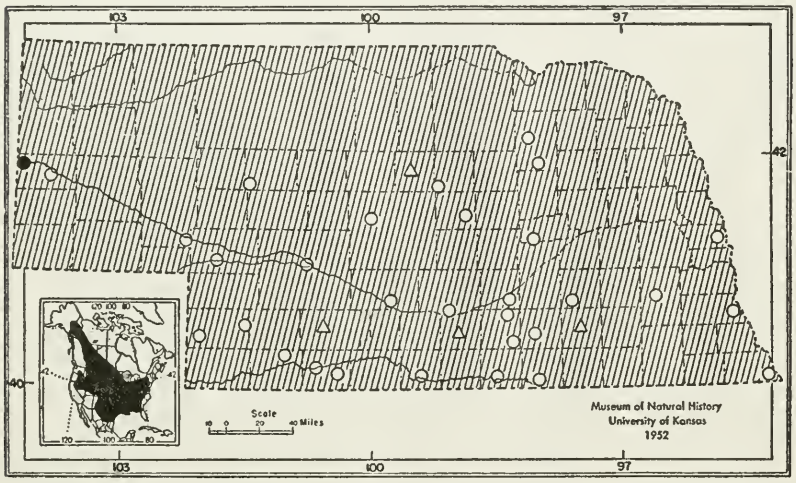

FIG. 77. Former distribution of *Bison bison bison* in Nebraska. For explanation of symbols see Fig. 5.

"Our view of the opposite margin of the Platte, during this day's march, had been intercepted by an elevated swell of the surface, which extended along, parallel to the rivers, that we were now approaching. Immediately upon surmounting this undulation we saw before us, upon the broad expanse of the left margin of the river, immense herds of bisons, grazing in undisturbed possession, and obscuring, with the density of their numbers, the verdant plain; to the right and left, as far as the eye was permitted to rove, the crowd seemed hardly to diminish, and it would be no exaggeration to say, that at least ten thousand here burst on our sight in the instant. Small columns of dust were occasionally wafted by the wind from bulls that were pawing the earth, and rolling; the interest of action was also communicated to the scene, by the unwieldy playfulness of some individuals, that the eye would occasionally rest upon, their real or affected combats, or by the slow or rapid progress of others to and from their watering places. On the distant bluffs, individuals were constantly disappearing, whilst others were presenting themselves to our view, until, as the dusk of the evening increased, their massive forms, thus elevated above the line of other objects, were

but dimly defined on the skies. We retired to our evening fare, highly gratified with the novel spectacle we had witnessed, and with the most sanguine expectations of the future.

"In the morning we again sought the living picture, but upon all the plain which last evening was so teeming with noble animals, not one remained."

The year of extirpation of wild bison in Nebraska is not certainly known. Garretson (1938:154-155) believed that the last individuals taken in the state were members of a small herd at the "head of the Dismal River" [Hooker County] killed by Indians from the Rosebud Reservation in the winter of 1882-83. Earlier in 1882 this band consisted of 28 adults and seven or eight calves. Hornaday (1889:501), however, reported that calves were taken as late as 1885 near Ogallala and several historical accounts support the claim that bison lingered in the North Platte Valley at least until that year. The most recent record from south of the Platte is that of eight or 10 animals killed in 1878 along the Frenchman River above Culbertson (Swenk, MS). In the eastern part of the state individuals were reported along the Missouri River as late as the middle 1860's.

The bison, like most other wild ungulates, thrives in semi-captivity under proper conditions and many were captured and pastured with cattle by early settlers in the state. Some of the individuals now existing on public and private reservations in Nebraska possibly descended from native stock. The largest herd in the state is on the Ft. Niobrara National Wildlife Refuge.

Females bear calves (usually one, infrequently twins) in spring (March to June) after a gestation period of nine to nine and a half months.

The bison was originally described in the genus *Bos* (domestic cattle and allies) Linnaeus, 1758, but later was made the type species of *Bison* Hamilton-Smith, 1827. Most subsequent workers have employed *Bison,* although the morphological characters that separate *B. bison* from *Bos taurus* (domestic cow) are not overwhelming and the two species are evidently completely cross-fertile (but seemingly only the females of the F_1 generation are fertile). Lately, Stormont *et al.* (1961) found striking similarities and only a few differences between the blood groups of *B. bison* and *B. taurus* and concluded (p. 208): "On the basis of the evidence on blood groups . . . further consideration should be given to the proposition that the American buffalo and domestic cattle deserve to be recognized as members of the same genus."

Bison bison bison (Linnaeus)

[Bos] bison Linnaeus, Systema naturae, ed. 10, 1:72, 1758 (type locality restricted to ancient "Quivera," central Kansas, by Hershkovitz, Proc. Biol. Soc. Washington, 70:31-32, June 28, 1957).

B[ison]. bison, Jordan, Manual of the vertebrate animals . . ., ed. 5, p. 337, 1888.

Bison bison septemtrionalis [sic] Figgins, Proc. Colorado Mus. Nat. Hist., 12:28, December 5, 1933 (type locality, 6 mi. NE Palmer, *in* Nance Co., Nebraska).

Bos bison, James, Account of an expedition from Pittsburgh to the Rocky Mountains . . ., 1:370, 1823.

Bison americanus, J. A. Allen, Mem. Mus. Comp. Zool., 4(10):36, 1876; J. A. Allen, Ninth Ann. Rept. U. S. Geol. Surv. (for 1875), 9:445, June, 1877; Hornaday, Ann. Rept. U. S. Nat. Mus. (for 1887), p. 377 (see especially pp. 421, 491, 501), 1889.

Bos Americanus, Aughey, Sketches of the physical geography and geology of Nebraska, p. 117, 1880.

Bison bison, Elliott, Field Columb. Mus., Publ. 115 (Zool. Ser.) 8:100, 1907; Swenk, Proc. Nebraska Acad. Sci., 8:77, September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:21, September, 1908; Jones, Bull. Univ. Nebraska State Mus., 4:96, November 26, 1962.

Bison bison bison, Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:17, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Beed, Bull. Conserv. Surv. Div., Univ. Nebraska, 10:21, October, 1936; Swenk, Nebraska Bird Rev., 5:53, July 31, 1937.

[Bison bison] bison, Seton, Lives of game animals . . ., 3:643 (see especially p. 682), 1929.

B[ison]. b[ison]. bison, Jones, Trans. Kansas Acad. Sci., 60:281, October 22, 1957.

Distribution in Nebraska.—Formerly state-wide; now extinct except on reservations where the species has been reintroduced. See Fig. 77.

Measurements.—No measurements of Nebraska-taken bison are available to me. Seton (1929, 3:641) recorded the range in external measurements of adult males as: 3042-3803; 507-913; 584-661. Adult females are somewhat smaller than males. See Skinner and Kaisen (1947:162) for cranial measurements.

Remarks.—Insofar as I know, no wild bison from Nebraska that was obtained in the flesh is preserved in any North American museum, a paradox of some proportions considering the hundreds of thousands that were slaughtered by the white man in the state.

Records of occurrence.—Specimens examined, 3, as follows: CHERRY COUNTY: *Ft. Niobrara Nat'l Wildlife Refuge* (introduced), 2 (USNM). SCOTTS BLUFF COUNTY: E of Lyman, 1 (Scotts Bluff Nat'l Mon. Collection).

Selected additional records (Jones, 1962:96-97, unless otherwise noted): ADAMS COUNTY: sec. 12, T. 8 N, R. 10 W, Highland Twp.; southeastern part of county (Swenk, MS). ANTELOPE COUNTY: Elkhorn River, 8 mi. NW Neligh; Cedar Creek, S of Neligh (Cary, MS); *"a few" mi. W Elgin* (Cary, MS). BUFFALO COUNTY: Kearney (Swenk, MS). CHASE COUNTY: 12 mi. N Wauneta (Hill and Metcalf, 1942:204, archeological site); Mud Springs, sec. 20, T. 6 N, R. 40 W. CLAY COUNTY: Lone Tree Twp. CUSTER COUNTY: "West Table," W of Merna. DAWSON COUNTY: near Plum Creek [= Lexington] (Hornaday, 1889:421). DOUGLAS COUNTY: within 10 mi. Omaha. FILLMORE COUNTY: no specific locality. FRONTIER COUNTY: along Medicine

Creek. GARDEN COUNTY: Ash Hollow, 3 mi. SE Lewellen (Champe, 1946:43, archeological site). GARFIELD COUNTY: near fork of Loup and Calamus rivers. HALL COUNTY: south of Platte River. HARLAN COUNTY: Alma. HITCHCOCK COUNTY: Frenchman River, above Culbertson. HOOKER COUNTY: head of Dismal River (Garretson, 1938:154). KEARNEY COUNTY: no specific locality. KEITH COUNTY: near Ogallala (Hornaday, 1889:501). LANCASTER COUNTY: near Lincoln (Hill and Cooper, 1937:246, archeological site). LINCOLN COUNTY: forks of the Platte (Hornaday, 1889:491). LOUP COUNTY: no specific locality. NANCE COUNTY: 6 mi. NE Palmer (Figgins, 1933:28). NUCKOLLS COUNTY: Lost Creek, near Superior; *no specific locality.* OTOE COUNTY: 1 mi. W Nebraska City. RED WILLOW COUNTY: McCook (Swenk, MS); divide between Beaver Creek and Republican River. RICHARDSON COUNTY: 4 mi. SE Rulo (Hill and Wedel, 1936:64, archeological site). SCOTTS BLUFF COUNTY: near Gering. VALLEY COUNTY: ¾ mi. N, 6 mi. W North Loup (Hill and Kivett, 1941:183, archeological site). WEBSTER COUNTY: Red Cloud. YORK COUNTY: Hays Twp.

Ovis canadensis

Mountain Sheep

The mountain sheep formerly occurred in Nebraska on the Wildcat Ridge, the Bighorn Ridge, and among the rough buttes and canyons along the North Platte River east at least as far as Birdwood Creek where Major Frank North saw a lone male in 1877 (Grinnell, 1904:325). The species occurred also on the Pine Ridge and the adjacent badlands in the northwestern part of the state and in the breaks along the Niobrara River east at least to the vicinity of Long Pine where horns were found in the 1870's (Swenk, MS).

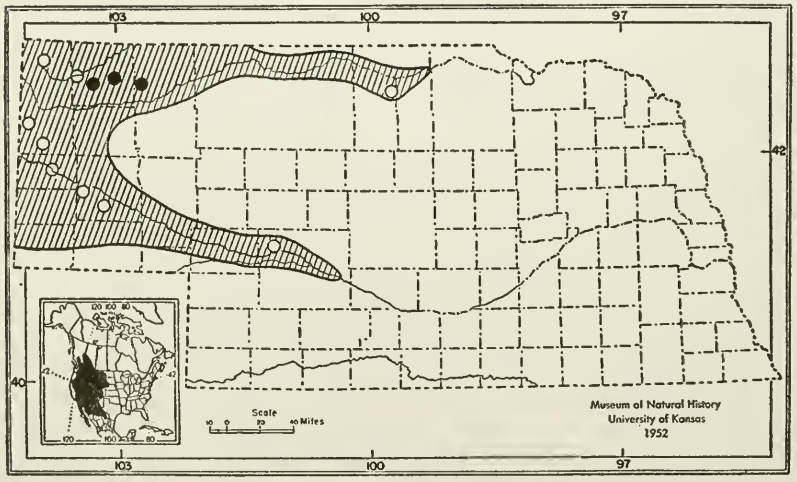

FIG. 78. Former distribution of *Ovis canadensis auduboni* in Nebraska. For explanation of symbols see Fig. 5.

Even though a few mountain sheep have been seen from time to time since 1900 along the North Platte River in the extreme western part of the state (see remarks beyond), it seems that the subspecies native to Nebraska, *O. c. auduboni,* was extirpated in the state by about 1890. Seton (1929, 3:535), however, reported a few animals as inhabiting the Pine Ridge Indian Reservation in adjacent South Dakota as late as 1902.

Insofar as I am aware, no wild-taken specimen of *O. canadensis* is extant from Nebraska. All records of occurrence are reports in the literature of animals observed or are skeletal parts recovered long after death.

Ovis canadensis auduboni Merriam

Ovis canadensis auduboni Merriam, Proc. Biol. Soc. Washington, 14:31, April 5, 1901 (type locality, Upper Missouri, probably Badlands between the Cheyenne and White rivers, South Dakota, according to footnote in original description); Swenk, Nebraska Blue Book, p. 851, 1915; Swenk, Nebraska Blue Book, p. 408, December, 1918; Swenk, Contrib. Dept. Ent., Univ. Nebraska, 23:17, March 1, 1919; Swenk, Nebraska Blue Book, p. 480, December, 1920; Grinnell, American big game and its haunts, p. 279 (see pp. 325-326), 1904; Cowan, Amer. Midland Nat., 24:542, November, 1940; Jones, Nat. Hist. Misc., Chicago Acad. Sci., 91:1, November 16, 1951; Hall and Kelson, The mammals of North America, p. 1031, March 31, 1959; Buechner, Wildlife Monog., 4:18, May, 1960; Velich, Jour. Mamm., 42:94, February 20, 1961; Jones, Bull. Univ. Nebraska State Mus., 4:98 (in text), November 26, 1962.

O[vis]. c[anadensis]. auduboni, Swenk, Proc. Nebraska Acad. Sci., 8:76 (in text), September, 1908; Swenk, Studies Zool. Lab., Univ. Nebraska, 89:20 (in text), September, 1908; Jones, Trans. Kansas Acad. Sci., 60:281, October 22, 1957.

Distribution in Nebraska.—Formerly in hills and breaks of Panhandle, east along Platte River at least to Lincoln County and east along Niobrara at least to Brown County; now extinct. See Fig. 78.

Measurements.—Some cranial measurements of a male from near Hay Springs are: length of nasals, 117.3; zygomatic breadth, 179.0; interorbital constriction, 128.7; length of maxillary tooth-row, 95.4. No external measurements of *O. c. auduboni* are available from Nebraskan specimens. The only external measurements of any individuals of the subspecies appear to be those given by Audubon and Bachman (1856, 2:165) for a male and female from western North Dakota.

Remarks.—According to the best available evidence (Buechner, 1960:18-22; Cowan, 1940:542-543) the subspecies *O. c. auduboni* is extinct; formerly it occurred in the western parts of Nebraska and the Dakotas and in adjoining parts of Montana and Wyoming.

Seemingly, mountain sheep have invaded Nebraska from Wyoming along the North Platte River at several times since 1900. A newspaper account from Swenk's (MS) file, dated January 18, 1918, reported that a group of seven spent a part of the cold winter of

1917-18 in the vicinity of Scottsbluff. One of these was shot by a local resident according to the account but officials took no action against the poacher because the statutes of Nebraska pertaining to protection of big game made no mention of mountain sheep. Dr. C. B. Schultz informed me (personal communication) that members of field parties from the Nebraska State Museum saw mountain sheep on several occasions in the same area in the early 1930's and as recently as 1957 a conservation officer of the Nebraska Game, Forestation and Parks Commission reported at least one individual, of which he claimed to have photographs, living in the rough breaks south of the North Platte in the vicinity of Bridgeport, Morrill County. Inasmuch as *O. c. auduboni* is thought to be extinct, these reports probably relate to mountain sheep of the subspecies *O. c. canadensis,* which formerly occurred nearest to Nebraska in the mountains of Colorado and Wyoming (but they may relate instead to *O. c. nelsoni,* some individuals of which were introduced into Wyoming a decade or so ago).

Records of occurrence.—Specimens examined, 3, as follows: DAWES COUNTY: Chadron State Park, 1 (RV); 10 mi. S, 1 mi. W Whitney, 1 (collection of Lemmon family, Whitney, Nebraska). SHERIDAN COUNTY: near Hay Springs, 1 (UNDZ).

Additional records: BROWN COUNTY: near Long Pine (Swenk, MS). DAWES COUNTY: near Crawford (Swenk, MS). LINCOLN COUNTY: Birdwood Creek (Grinnell, 1904:325). MORRILL COUNTY: Courthouse Rock (Grinnell, 1904:326); 5 mi. S Chimney Rock (photograph courtesy Edson Fichter). SCOTTS BLUFF COUNTY: vicinity Scottsbluff (Jones, 1962:98). SIOUX COUNTY: "Hat Creek Breaks," 30 mi. N Agate (Cook, 1931:170); Spoon Butte (Cook, 1931:171); 23 mi. S Agate (Cook, 1931:171).

INTRODUCED MAMMALS

Five non-native species of mammals are treated below. One, the coypu, is a native of South America. The other four are natives of Eurasia. Species like the armadillo (*Dasypus novemcinctus*), escapees of which are reported occasionally in newspaper accounts, and the murine opossum (*Marmosa* sp.), a female and young of which arrived in Lincoln on June 3, 1931, amidst bunches of bananas (Hudson, 1932:159), have not been treated; neither have the domesticated species brought to the state by man been accounted for even though occasional individuals of some live in the feral state.

Insofar as I am aware no species of North American mammal not native to Nebraska has become established in the state through introduction. Stocks of a few species native to Nebraska have been liberated there from places outside the state and these instances are mentioned in the accounts of the species concerned.

All five species included here are treated in the appropriate keys in the foregoing text.

Family LEPORIDAE—Hares, Rabbits and Pikas

Oryctolagus cuniculus (Linnaeus)

European Rabbit

[Lepus] cuniculus Linnaeus, Systema naturae, ed. 10, 1:58, 1758 (type locality, "in Europa australi").

O[ryctolagus]. cuniculus, Lyon, Smiths. Misc. Coll., 45:106, June 15, 1904.

Distribution in Nebraska.—Known in the feral state only from Madison County. See Fig. 81.

Measurements.—External and cranial measurements of a male from Madison County are: 514; 52; 110; 79; weight 5 lbs.; greatest length of skull, 92.5; zygomatic breadth, 43.5; length of nasals, 41.7; postorbital constriction, 12.4; length of maxillary tooth-row, 15.7; length of incisive foramen, 24.0; breadth of mesopterygoid fossa, 5.7; least length of palatal bridge, 8.5.

Remarks.—The only wild-taken European rabbit known from Nebraska is an individual (in wild-type pelage) that was caught by a dog on the State Game Farm at Madison on February 14, 1958. I have no information concerning the introduction of wild European rabbits into Nebraska. Individuals of the domesticated strains of the species, the so-called Belgian hare, probably have been released or have escaped from confinement from time to time but Presnall (1958:47) indicated that no known naturalizations had resulted on the mainland of the United States from such releases or escapes. The large size of the Nebraskan specimen suggests that it may have been derived from domestic stock.

Insofar as known only one subspecies of the species, *O. c. cuniculus,* has been introduced into North America.

Record of occurrence.—Specimen examined, 1, as follows: MADISON COUNTY: State Game Farm, Madison, 1.

Family MURIDAE—Old World Rats and Mice

Mus musculus Linnaeus

House Mouse

[Mus] musculus Linnaeus, Systema naturae, ed. 10, 1:62, 1758 (type locality restricted to Upsala, Sweden, by Thomas, Proc. Zool. Soc. London, p. 147, March 22, 1911).

Distribution in Nebraska.—State-wide in and near the habitations of man. See Fig. 79.

External measurements.—Average and extreme measurements of 10 specimens (four males, six females) from the Panhandle are: 173.4 (166-178); 83.7 (80-87); 19.2 (18-20); 13.8 (13-15). For cranial measurements see Table 26.

A female from Richardson County weighed 27.8 grams; a male and female from Sioux County weighed 21.7 and 25.7 grams, respectively.

Remarks.—The house mouse is a common, often abundant, resident in and near the habitations of man in Nebraska. Feral populations are occasionally encountered, especially in the eastern third of the state.

According to James (1823:370) the species was first introduced in Nebraska at the Engineer Cantonment in Washington County by Major Long's expedition in the winter of 1819-20. It spread westward in the wake of settlement by man and as early as 1908 was an "abundant and highly injurious pest throughout the state, frequenting both buildings and fields," according to Swenk (1908:92).

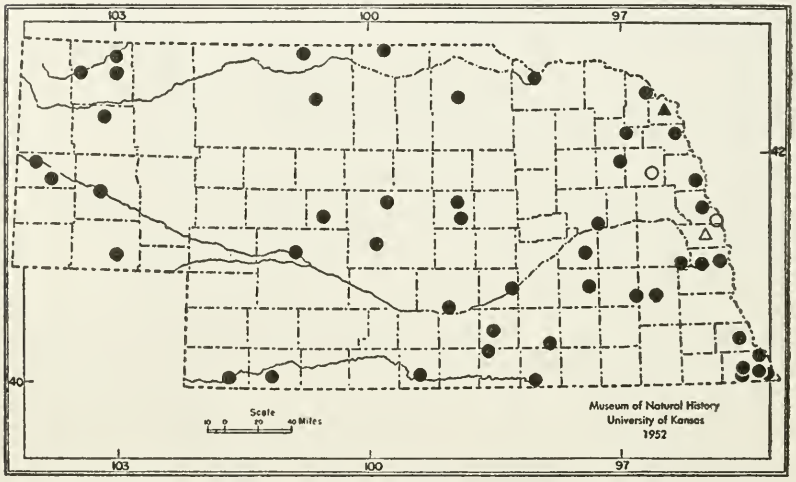

FIG. 79. Records of occurrence of *Mus musculus* in Nebraska. For explanation of symbols see Fig. 5.

The house mouse is sometimes confused with native species of the cricetid genera *Reithrodontomys* and *Peromyscus*. From these it differs in having nearly naked ears, a scantily haired tail that bears scaly annulations, a grayish or buffy (rather than whitish) venter, three longitudinal rows of tubercles on the molars, and a distinct notch on the occlusial surface of each upper incisor (seen best in lateral view). It differs additionally from harvest mice in having the anterior surface of each upper incisor smooth instead of grooved.

Probably the house mouse breeds the year around in Nebraska. Three females taken in the months of April, May and September carried 5, 8, and 6 embryos, respectively.

I have made no attempt to assign Nebraskan specimens of *M. musculus* to subspecies. According to Schwarz and Schwarz (1943), who devised a complicated and to me unconvincing arrangement of "wild" and "commensal" subspecific stocks, two subspecies, *M. m. domesticus* Rutty, 1772, of northwestern Europe, and *M. m. brevirostris* Waterhouse, 1837, of southern Europe, have been introduced into North America.

Records of occurrence.—Specimens examined, 144 as follows: ADAMS COUNTY: 5 mi. NE Holstein, 1 (UNDZ); *no specific locality,* 3 (HM). BOX BUTTE COUNTY: Hemingford, 1 (NSM). BUFFALO COUNTY: Kearney, 1 (USNM). BURT COUNTY: 1 mi. E Tekamah, 1. CHERRY COUNTY: W of Crookston, 1 (NSM); Hackberry Lake, 1 (UMMZ). CHEYENNE COUNTY: 4 mi. E. Sidney, 20. CLAY COUNTY: Edgar, 1 (USNM). CUSTER COUNTY: ½ mi. E Victoria Springs, 2 (UMMZ); Callaway, 2 (USNM). DAKOTA COUNTY: no specific locality, 1 (NSM). DAWES COUNTY: Chadron, 1 (CSTC); 10 mi. S Chadron, 3 (UMMZ); *3 mi. W Crawford,* 1 (NSM); *1 mi. W Crawford,* 1 (NSM); Crawford, 1 (NSM). DIXON COUNTY: 3 mi. NE Ponca, 1. DUNDY COUNTY: 2 mi. SW Benkelman, 5. HALL COUNTY: 6 mi. S Grand Island, 1. HARLAN COUNTY: 1 mi. W Alma, 2. HITCHCOCK COUNTY: 8 mi. S, 3 mi. W Trenton, 1. HOLT COUNTY: 1 mi. S Atkinson, 1 (NSM). KEYA PAHA COUNTY: 12 mi. NNW Springview, 2. KNOX COUNTY: 1 mi. W Niobrara, 1; *Niobrara State Park,* 1 (NGFPC). LANCASTER COUNTY: within 5 mi. Lincoln, 27 (1 NGFPC, 21 UC, 3 UNDZ). LINCOLN COUNTY: 2 mi. N, 5 mi. W North Platte, 2720 ft., 1; *2 mi. N North Platte,* 1. LOGAN COUNTY: 2 mi. NE Stapleton, 1. MORRILL COUNTY: 1 mi. N Bridgeport, 1. NEMAHA COUNTY: South Auburn, 2 (USNM). NUCKOLLS COUNTY: 2 mi. WSW Superior, 4. PLATTE COUNTY: Columbus, 1 (USNM). POLK COUNTY: Osceola, 1 (UC). RICHARDSON COUNTY: 4 mi. E Barada, 3; 3½ mi. S, 1 mi. W Dawson, 1; 2 mi. N Falls City, 3; 3-5 mi. SE Rulo, 4 (3 NGFPC); *3 mi. S Rulo,* 1; Nebraska-Kansas line, 7 mi. N Sabetha, Kansas, 1. SARPY COUNTY: 2 mi. ESE La Platte, 2; 1 mi. W Meadow, 1. SAUNDERS COUNTY: 2 mi. NW Ashland, 1. SCOTTS BLUFF COUNTY: ½-1 mi. S Mitchell, 11; 5 mi. S Gering, 2. SIOUX COUNTY: *5½ mi. W Crawford,* 1 (NSM); *1 mi. S, 4 mi. W Crawford,* 2 (NSM). STANTON COUNTY: 1½ mi. S Pilger, 1. SEWARD COUNTY: 1 mi. N Pleasant Dale, 1. THURSTON COUNTY: 1 mi. S Winnebago, 3. VALLEY COUNTY: 2 mi. W Ord, 1; 10 mi. S Ord, 1 (NGFPC). WASHINGTON COUNTY: Blair, 2 (UMMZ); *1 mi. E Blair,* 1; *6 mi. SE Blair,* 1. WAYNE COUNTY: 2½ mi. E Wayne, 2. WEBSTER COUNTY: Bladen, 1 (HM). YORK COUNTY: Waco, 1 (UMMZ).

Additional records: CUMING COUNTY: West Point (Swenk, MS). DOUGLAS COUNTY: no specific locality (Fichter, 1941:28). WASHINGTON COUNTY: Engineer Cantonment [= approximately 2 mi. E Ft. Calhoun] (James, 1823:370).

Rattus norvegicus (Berkenhout)

Norway Rat

Mus norvegicus Berkenhout, Outlines of the natural history of Great Britain and Ireland, 1:5, 1769 (type locality, England, where the species was introduced from Asia, probably via Continental Europe, in the early 1700's).

Rattus norvegicus, Hollister, Proc. Biol. Soc. Washington, 29:126, June 6, 1916.

Distribution in Nebraska.—State-wide in and near the habitations of man. See Fig. 80.

External measurements.—Measurements of three males from Nebraska are: 440, 378, 372; 199, 181, 164; 43, 43.5, 41; 21.5, 24, 22. The first-listed specimen weighed approximately 454 grams and the second-listed weighed 253 grams. For cranial measurements see Table 26.

Remarks.—The Norway rat was introduced into the eastern United States from the Old World at about the time of the American Revolution (Silver, 1941:2). I do not know the history of its introduction and spread in Nebraska; probably the species was introduced at river towns along the Missouri in the 1850's and spread

westward coincident with settlement of other parts of the state. By the early 1900's it was an "abundant and highly injurious pest throughout the state, frequenting both buildings and fields" (Swenk, 1908:92). In my experience the Norway rat is mostly limited in Nebraska to the immediate environs of habitations of man.

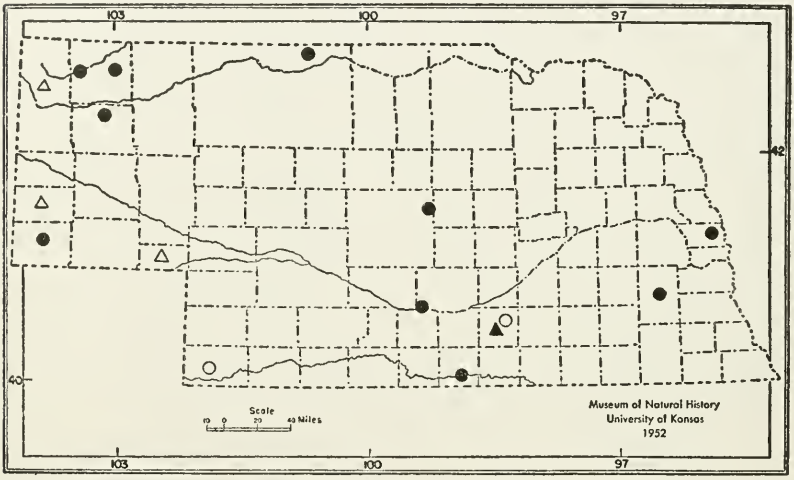

FIG. 80. Records of occurrence of *Rattus norvegicus* in Nebraska. For explanation of symbols see Fig. 5.

Insofar as known *R. norvegicus* is the only species of the genus found in Nebraska although at least three subspecies of another species, *Rattus rattus,* also have been introduced into the United States. If it occurs at all in Nebraska, *R. rattus,* the black rat, probably will be found only in large urban areas such as Omaha and Lincoln. *R. rattus* differs from *R. norvegicus* as follows: tail longer, rather than shorter, than head and body; ears larger, measuring approximately 21 mm. instead of approximately 18 mm.; females normally having 10 mammae instead of 12; temporal ridges of skull strongly bowed outward posteriorly rather than approximately parallel.

The number of young per litter of *R. norvegicus* usually ranges between 2 and 14; litters of more than 14 are occasionally reported. The species breeds the year around.

Only one subspecies of the Norway rat, *R. n. norvegicus,* is known to have been introduced into the United States.

Records of occurrence.—Specimens examined, 36, as follows: ADAMS COUNTY: no specific locality, 1 (HM). BOX BUTTE COUNTY: Hemingford, 1 (NSM). BUFFALO COUNTY: Elm Creek, 1 (HM). CHERRY COUNTY: W of Crookston, 2 (NSM). CUSTER COUNTY: Comstock, 1 (AMNH). DAWES

COUNTY: 9 mi. S Chadron, 1 (UMMZ); Crawford, 8 (NSM). DOUGLAS COUNTY: 2 mi. N junction highways 133 and 64 (on 133), W of Omaha, 1. FRANKLIN COUNTY: 1½ mi. S Franklin, 1. KIMBALL COUNTY: 3 mi. E Kimball, 1. LANCASTER COUNTY: within 6 mi. Lincoln, 18 (2 NGFPC, 3 NSM, 9 UC, 4 UNDZ).

Additional records: ADAMS COUNTY: Hastings (Gates, 1945:13). BANNER COUNTY: no specific locality (Fichter, 1941:28). DEUEL COUNTY: no specific locality (Rapp and Gates, 1957:53). DOUGLAS COUNTY: *near Irvington* (Haecker, 1941:10). DUNDY COUNTY: 5 mi. N, 2 mi. W Parks (Jones, 1954: 485). SIOUX COUNTY: no specific locality (Fichter, 1941:28).

TABLE 26.—CRANIAL MEASUREMENTS OF RATTUS NORVEGICUS AND MUS MUSCULUS.

Catalogue number and sex	Greatest length of skull	Zygomatic breadth	Interorbital constriction	Depth of skull	Length of maxillary tooth-row	Length of incisive foramen	Length of nasals
Rattus norvegicus, W of Omaha, Douglas County							
81858 KU, ♂	51.9	24.3	6.4	17.9	7.6	9.4	19.8
Mus musculus, 4 mi. E Sidney, Cheyenne County							
77545 KU, ♂	21.5	11.4	3.6	7.9	3.5	4.6	7.9
77551 KU, ♂	22.2	11.6	3.6	7.9	3.7	4.8	8.2
77552 KU, ♀	22.0	11.7	3.5	7.8	3.9	4.9	8.3
77556 KU, ♀	21.3	11.3	3.4	8.0	3.6	4.7	7.8

Family CAPROMYIDAE—Capromyids

Myocastor coypus (Molina)

Coypu or Nutria

Mus coypus Molina, Saggio sulla storia naturale de Chili, pp. 287-288, 342, 1782 (type locality, rivers of Chile).

Myocastor Coypus, Kerr, The animal kingdom . . ., p. 225, 1792.

Distribution in Nebraska.—Only two wild-taken specimens known from the state, one from the Republican River and the other from the Missouri River. See Fig. 81.

Measurements.—External measurements of a female from Dundy County are: 1004; 419; 146; —; weight, 13 lbs. 12 ozs. Velich (1961:93) recorded a male from Sarpy County as weighing an estimated 20 lbs.

Remarks.—Almost certainly the nutria was first brought to Nebraska by persons who hoped to market pelts of the species. Some individuals subsequently escaped confinement or were knowingly released when the anticipated high returns for pelts failed to materialize on the fur market. According to de Vos *et al.* (1956:173) the fur "commands a low price and is in little demand." I have no information to suggest anything more than sporadic occurrence of the species in the state and it seems unlikely that colonies have become established, except possibly along the Missouri River.

Myocastor coypus was introduced into the United States from Argentina in the late 1930's. The species has become established in the marshes along the Gulf Coast where it competes with the native muskrat (a more valuable fur-bearer). It is not certainly known whether more than one subspecies of *M. coypus* was released in North America but available information suggests that only *M. c. bonariensis* É. Geoffroy St.-Hilaire, 1805, was introduced.

Records of occurrence.—Specimen examined, 1, as follows: DUNDY COUNTY: Republican River, near Max, 1 (NSM).

Additional record: SARPY COUNTY: Missouri River, N of Bellevue (Velich, 1961:93).

Family CERVIDAE—Deer and Allies

Dama dama (Linnaeus)

Fallow Deer

[Cervus] dama, Linnaeus, Systema naturae, ed. 10, 1:67, 1758 (type locality, Sweden, where the species was introduced; fallow deer occurred natively only in the regions north and east of the Mediterranean Sea).

Dama dama, Lataste, Act. Soc. Linn. Bordeaux, 39:288, 1885.

Distribution in Nebraska.—Beaver Creek Valley and adjacent areas in east-central part of state. See Fig. 81.

Measurements.—External measurements (after Rode and Didier, 1946:184-185) are: length of head and body, 1300-1500; length of tail, 160-190; weight, 110 lbs. (females) to 143 lbs. (males).

Remarks.—Fallow deer were released in Nebraska in 1939 (20 head) and 1940 (53 head) on the Hall Ranch, 10 mi. NW Petersburg, the animals being supplied by the Lincoln City Park Department (see Presnall, 1958:48). The species thrived, reproduced, and extended its distribution from the point of original release; now fallow deer occur throughout the Beaver Creek Valley and in adjacent parts of the Cedar Creek Valley and the lower Loup Valley. Aerial surveys in 1957, 1958, 1959, and 1960 by personnel of the Nebraska Game, Forestation and Parks Commission revealed the number of animals in Beaver Valley alone to be 126, 105, 157, and 139, respectively. Probably the number of fallow deer in the wild in Nebraska now approximates 500.

According to Vance *et al.* (1958:41), a small herd (17-20 individuals) also has been released in the vicinity of Fairbury.

Dama dama is a monotypic species.

Records of occurrence.—Specimens examined, none.

Additional records (Packard, 1955:471-472, unless otherwise noted): BOONE COUNTY: Hall Ranch, 10 mi. NW Petersburg; *Matson Ranch, sec. 23, T. 22 N, R. 8 W;* 5 mi. S, 2 mi. W Petersburg. GREELEY COUNTY: Cedar Creek, 5 mi. NW Spalding. HALL COUNTY: "area of Grand Island." HOWARD COUNTY: North Loup River, 1½ mi. E Cotesfield. JEFFERSON COUNTY: vicinity Fairbury (see text above). WHEELER COUNTY: secs. 20-25, T. 23 N, R. 10 W.

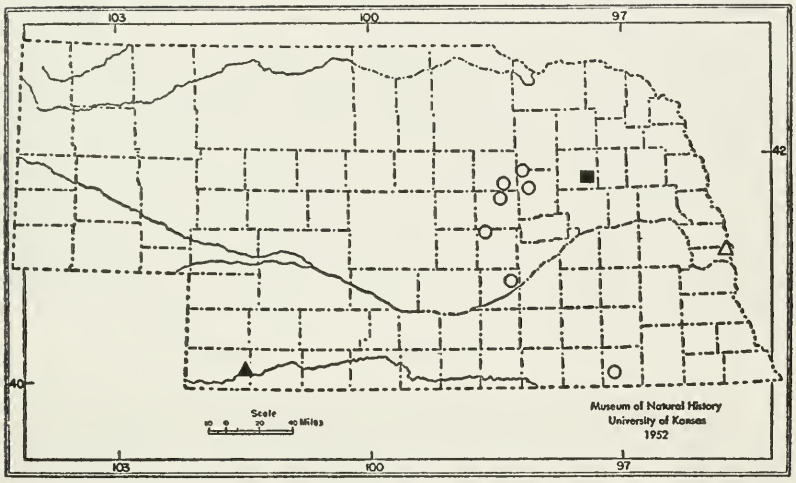

FIG. 81. Records of occurrence of three introduced mammals in Nebraska. *Oryctolagus cuniculus* (square). *Myocastor coypus* (triangles). *Dama dama* (circles).

SPECIES OF UNVERIFIED OCCURRENCE

Species Incorrectly Reported from Nebraska

In the first attempt to provide a list of mammals occurring in Nebraska Samuel Aughey ("Sketches of the physical geography and geology of Nebraska," pp. 117-122, 1880) recorded 82 species (exclusive of bats, no species of which was mentioned). Aughey's list, in large measure a compilation (with liberal extrapolation) from the available literature of his day, especially Baird (1858) and Coues and Allen (1877), contains some names that are questionably placed in synonymies in the foregoing text and some others that obviously do not apply to Nebraska. The latter are: *Sorex pachyurus* and *S[orex]. richa[rdsonii]* (p. 122), both synonyms of subspecies of *Sorex arcticus*, the Arctic shrew; pygmy shrew, *S[orex]. Hoyi* (p. 122); star-nosed mole, *Condylura cristata* (p. 122); shrew-mole, *Uratrichus [sic] gibbsii* (p. 122); snowshoe hare, *L[epus]. Americanus* (p. 122); yellow-bellied marmot, *A[rctomys]. flaviventer* (p. 120); golden-mantled ground squirrel, *Spermaphilus [sic] lateralis* (p. 120); Gunnison's prairie dog, *C[ynomys]. Gunnisonii* (p. 120); red squirrel, *S[ciurus]. Hudsonicus* (p. 120); plains pocket gopher, *G[eomys]. breviceps* (p. 121); sagebrush vole, *A[rvicola]. curtatus* (p. 122); marten, *Mustela Americana* (p. 119).

Three of these species also were admitted by Swenk (1908) in his preliminary list of Nebraskan mammals. Two, the marmot and the marten, evidently were retained by him on the strength of Aughey's mention of them; the third, the red squirrel (*Tamiasciurus hudsonicus dakotensis* J. A. Allen), is worthy of special note. Aughey simply mentioned that the "Pine Squirrel (*S. Hudsonicus*)" occurred occasionally in northern Nebraska. Swenk (p. 81) noted Aughey's report and went on to write that ". . . Professor Bruner

saw one in Squaw canyon [Sioux County] in the summer of 1892. Reports of a 'red squirrel' from the Niobrara valley near Cody . . . indicate that this squirrel may follow the Pine-clad canyons eastward for a distance."

It is possible that a small population of red squirrels, since extirpated, did reside on the Pine Ridge when the first settlers arrived but I doubt it. No specimen ever has been collected and I personally have searched unsuccessfully for the species on several occasions and have questioned residents of the Pine Ridge concerning its presence there, with negative results. It is known that the fox squirrel, *Sciurus niger rufiventer,* was introduced into the Pine Ridge country in the early days and Bruner, perhaps unaware of the introductions, may well have recorded one of these squirrels as *Tamiasciurus.* The fox squirrel certainly is the "red squirrel" reported from the vicinity of Cody.

Species Possibly Occurring in Nebraska

The following species are not now known to occur in Nebraska but have been recorded from sufficiently near the borders of the state that their presence is suspected. The reader is referred to Hall and Kelson, "The mammals of North America," 1959, for detailed information concerning the geographic distribution of each species.

Sorex merriami merriami Dobson, 1890—Merriam's Shrew. Known from several localities in eastern Wyoming; possibly occurs in extreme western part of state.

Microsorex hoyi hoyi (Baird, 1858)—Pygmy Shrew. Known from along Missouri River on South Dakota side opposite Dixon County; to be looked for in northeastern part of state.

Myotis grisescens A. H. Howell, 1909—Gray Myotis. Known from as near Nebraska as the Ozark Plateau of central Missouri; individuals may wander to southeastern part of state in summer.

Myotis sodalis Miller and Allen, 1928—Indiana Myotis. Same as for *M. grisescens* above.

Myotis thysanodes thysanodes Miller, 1897—Fringed Myotis. Known from Black Hills of South Dakota; possibly occurs on Pine Ridge and in adjacent areas of Panhandle.

Plecotus townsendii pallescens (Miller, 1897)—Townsend's Big-eared Bat. Same as for *M. thysanodes* above.

Tadarida molossa (Pallas, 1766)—Big Free-tailed Bat. Reported both from Iowa and Kansas; to be looked for in any part of state.

Dasypus novemcinctus mexicanus Peters, 1864—Nine-banded Armadillo. Known from as near southwestern Nebraska as along the Solomon River, Sheridan Co., Kansas (record on file, KU); probably will be found along southern border of state.

Sylvilagus nuttallii grangeri (J. A. Allen, 1895)—Nuttall's Cottontail. This species doubtfully occurs in timbered and brushy situations in extreme western part of Panhandle (see also discussion in account of *Sylvilagus floridanus*).

Spermophilus lateralis lateralis (Say, 1823)—Golden-mantled Ground Squirrel. Known from eastern Wyoming; doubtfully occurs on Wildcat Ridge and in adjacent areas in extreme western part of Panhandle.

Lagurus curtatus curtatus (Cope, 1868)—Sagebrush Vole. Same as for *S. lateralis* above.

Rattus rattus rattus (Linnaeus, 1758) and **Rattus rattus alexandrinus** (É. Geoffroy St.-Hilaire, 1803)—Black Rat. Introduced; may be found in larger urban areas, especially Omaha.

TYPE LOCALITIES OF MAMMALS IN NEBRASKA

ANTELOPE COUNTY:

1. Neligh. *Scalopus aquaticus caryi.*

BOYD COUNTY:

2. "The Tower," sec. 10, T. 34 N, R. 10 W, as herein restricted. *Arctomys ludoviciana [Cynomys ludovicianus ludovicianus].*
3. Spencer. *Geomys lutescens levisagittalis [Geomys bursarius lutescens].*

BROWN COUNTY:

4. Johnstown. *Canis nebrascensis [Canis latrans latrans].*

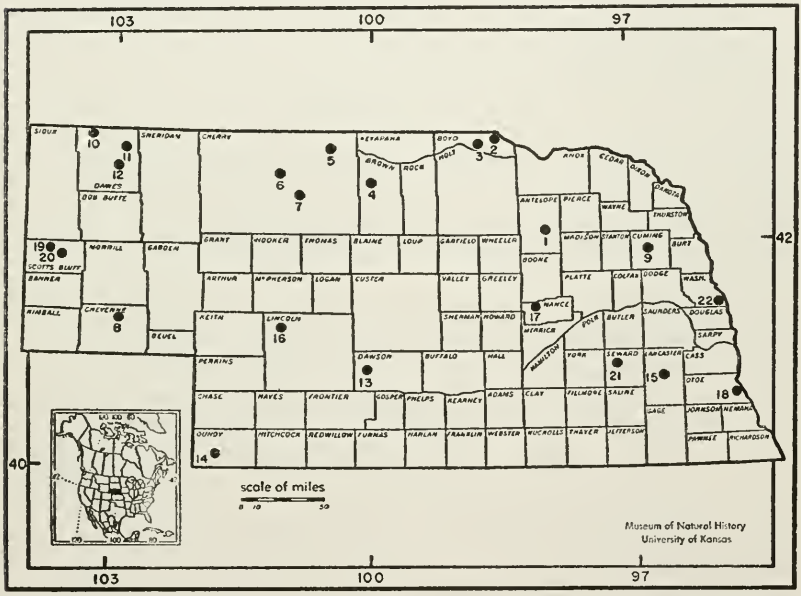

FIG. 82. Type localities of Recent mammals in Nebraska (see accompanying text).

CHERRY COUNTY:

5. Valentine. *Sylvilagus floridanus similis, Neotoma baileyi [Neotoma floridana baileyi].*
6. 18 mi. NW Kennedy. *Reithrodontomys albescens [Reithrodontomys montanus albescens].*
7. Kennedy. *Perognathus fasciatus flavescens [Perognathus flavescens flavescens], Reithrodontomys dychei nebrascensis [Reithrodontomys megalotis dychei], Peromyscus luteus [Peromyscus maniculatus luteus].*

CHEYENNE COUNTY:

8. 2 mi. S Dalton. *Thomomys talpoides cheyennensis.*

CUMING COUNTY:

9. Beemer. *Mustela campestris [Mustela nivalis campestris].*

DAWES COUNTY:

10. Wayside. *Thomomys talpoides pierreicolus.*
11. Little Bordeaux Creek, 3 mi. E Chadron. *Perognathus flavescens olivaceogriseus [Perognathus fasciatus olivaceogriseus].*
12. 10 mi. S Chadron. *Geomys lutescens hylaeus [Geomys bursarius lutescens].*

DAWSON COUNTY:

13. 50 mi. W Ft. Kearney [vicinity Gothenburg]. *Spermophilus obsoletus [Spermophilus spilosoma obsoletus].*

DUNDY COUNTY:

14. 5 mi. N, 2 mi. W Parks. *Synaptomys cooperi relictus, Microtus pennsylvanicus finitus.*

LANCASTER COUNTY:

15. Lincoln. *Geomys bursarius majusculus.*

LINCOLN COUNTY:

16. Sandhills on Birdwood Creek. *Geomys bursarius lutescens.*

MERRICK COUNTY:

17. 6 mi. NE Palmer. *Bison bison septemtrionalis [Bison bison bison].*

OTOE COUNTY:

18. Nebraska City. *Pteromys volans nebrascensis [Glaucomys volans volans].*

SCOTTS BLUFF COUNTY:

19. 3 mi. E Mitchell. *Erethizon epixanthum bruneri [Erethizon dorsatum bruneri].*
20. Scottsbluff. *Geomys lutescens vinaceus [Geomys bursarius lutescens].*

SEWARD COUNTY:

21. Lincoln Creek, W of Seward. *Lutra canadensis interior.*

WASHINGTON COUNTY:

22. Engineer Cantonment [approximately 2 mi. E Ft. Calhoun]. *Sorex brevicaudus [Blarina brevicauda brevicauda], Sorex parvus [Cryptotis parva parva], Vespertilio arquatus [Eptesicus fuscus fuscus], Vespertilio pruinosus [Lasiurus cinereus cinereus], Canis latrans [Canis latrans latrans], Canis nubilus [Canis lupus nubilus].*

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Synopsis of the Lagomorphs and Rodents of Korea

BY

J. KNOX JONES, JR., AND DAVID H. JOHNSON

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1965

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INTRODUCTION

The lagomorphs and rodents of Korea have never before been reviewed systematically. Aside from descriptions of new taxa, most of the accounts in the literature concerning Korea deal with small collections from widely scattered localities (see, for example, Allen and Andrews, 1913, Kuroda, 1917 and 1934, Mori, 1938 and 1939, Thomas, 1907*a* and 1907*b*, and Won and Woo, 1956 and 1959) or are compilations of a general nature, such as those of Kuroda (1938 and 1940), Tokuda (1941), Won and Woo (1958*b*), and Won (1961), some annotated, of the known elements of the fauna.

The present paper is an outgrowth of studies relating to hemorrhagic fever that were initiated by the U. S. Army in the early 1950's. In this connection, we undertook a systematic appraisal of Korean mammals, some results of which have been published previously (Johnson and Jones, 1955*a* and 1955*b*, Jones and Johnson, 1955, 1956, and 1960, Jones, 1956 and 1959). Herein is set forth a systematic review of the three species of lagomorphs and 16 species of rodents presently known to occur in Korea, based principally on specimens acquired through the auspices of the Field Unit of the Commission on Hemorrhagic Fever, Armed Forces Epidemiological Board, with which one of us (Jones) was associated in 1954 and 1955.

The majority of the specimens available to us for study (a total

of 1471) originated from the central and southern parts of the Korean Peninsula. We have been able to examine only limited materials from northern Korea and the adjacent parts of Manchuria and Siberia, and the present treatment must be regarded, therefore, as provisional. Most of the specimens examined are housed in the United States National Museum (USNM). Some are in the Museum of Natural History of The University of Kansas (KU) and still others are scattered among institutions in North America and the Old World as follows: American Museum of Natural History (AMNH); British Museum (Natural History) (BM); Carnegie Museum (CM); Museum of Comparative Zoology, Harvard (MCZ); Museum of Vertebrate Zoology, University of California (MVZ); Museum of Zoology, University of Michigan (UMMZ), including the collections formerly in the Cleveland Museum of Natural History (CMNH); National Science Museum of Japan (NSMJ); Sung Kung Kwang University, Seoul, Korea (SKKU); and Yamashina Institute for Ornithology and Zoology, Tokyo (YI). We are indebted to the persons in charge of these several collections for allowing us to study at the institution concerned or for the loan of specimens. In addition to specimens examined, reference is made in many accounts under "additional records" to any locality mentioned in the literature from which we did not examine specimens.

It is a pleasure to note here the surge of activity among Korean biologists, especially in natural history, since the end of the Korean War. In this regard, the contributions of P. O. Won and H. C. Woo (Won, 1961, Won and Woo, 1956, 1961, and elsewhere), some of which are in English and others of which have English summaries, are especially noteworthy. The training of these two investigators, however, apparently has been in forestry and ecology rather than in taxonomy as evidenced not only in their publications but also in our personal conversations with Won. Inasmuch as the contributions of Won and Woo and their colleagues necessarily have been made in the absence of adequate comparative materials and literature, we have relied upon their identifications only to the level of species. Actually, correct identification of faunal elements to the species level is all that is needed with reference to the studies in forestry now underway in Korea and it would seem appropriate for investigators there who are not familiar with procedures in systematic zoology to avoid the use of subspecific names.

Although this paper is a contribution from the Museum of Natural History of The University of Kansas and from the United States

National Museum, much of the work was sponsored by the Walter Reed Army Institute of Research. We are especially indebted to Henry S. Fuller of the mentioned Institute for his continued interest in our studies. We are grateful also to Nagamichi Kuroda, the late Tamezo Mori, and P. O. Won for their helpfulness in locating certain place-names in Korea and to Yoshinori Imaizumi for translations of papers in Japanese, and other courtesies.

All measurements in the accounts that follow are in millimeters. When known, the altitude at which specimens were obtained is recorded, either in feet (ft.) or meters (m.), depending on which was used on the specimen labels.

ORDER LAGOMORPHA

Three species of lagomorphs, two hares and a pika, are indigenous to Korea. Additionally, a feral population of the European rabbit, *Oryctolagus cuniculus,* may now exist (or may have existed for a time following cessation of hostilities) in the vicinity of Seoul. An adult male of this species (USNM 299505), in wild-type pelage, was captured on a military compound six miles east of Seoul in February, 1953, and was kept there until October 4, 1954. While a captive it mated successfully at least twice with domesticated females of *O. cuniculus* in a laboratory colony.

Family OCHOTONIDAE—Pikas

Ochotona hyperborea coreana Allen and Andrews

Northern Pika

Ochotona (Pika) coreanus Allen and Andrews, Bull. Amer. Mus. Nat. Hist., 32:429, September 2, 1913. Type locality: Pochong, 3000 ft., Korea.

Ochotona hyperborea coreana, Kuroda, A list of the Japanese mammals, p. 42, June 20, 1938.

Distribution in Korea.—Mountainous areas in extreme northeastern part, south at least to Ch'ail-bong.

Measurements.—External measurements of the holotype, an adult female, and an adult male topotype are, respectively: Length of head and body, 204, 195; length of hind foot, 30, 33; length of ear from notch (dry), 14.4, 16.7. Cranial measurements of the holotype (followed in parentheses by those available for the male) are: Occipitonasal length, 42.9; basal length, 36.6; zygomatic breadth, 22.1 (22.0); breadth across auditory bullae, 21.0 (20.7); interorbital breadth, 5.1; depth of braincase, 11.2; length of nasals, 13.6; length of incisive foramina, 6.7; length of molariform tooth-row, 8.4.

Remarks.—In the original description Allen and Andrews wrote of this animal as follows: "This species lives at a low altitude (about 3000 feet) for a pika, and not in rock piles as is so frequently the case. It was seen only at Pochong, where the three specimens were

taken." Mori (1939:4) recorded seeing a pika at Ch'ail-bong in (translated from Japanese) "a rocky region of the alpine zone."

Rumors of the occurrence of pikas in mountainous areas in central Korea remain to be verified.

Records of occurrence.—Specimens examined, 3, all from the type locality (AMNH 34049-51, including the holotype).

Additional records: Ch'ail-bong (Mori, 1939:4); Yonam-dong (Kishida and Mori, 1930:49); Paektu-san (Won, 1961:43).

Family Leporidae—Hares and Rabbits

Lepus coreanus Thomas

Korean Hare

Lepus sinensis coreanus Thomas, Ann. Mag. Nat. Hist., ser. 6, 9:146, February, 1892. Type locality: Seoul, Korea.

Lepus coreanus, Thomas, Proc. Zool. Soc. London, 1906:865, April 11, 1907.

Distribution in Korea.—Probably entire peninsula in suitable habitats.

Measurements.—External measurements of an adult male and adult female from the vicinity of Seoul are, respectively: Total length, 475, 490; length of tail-vertebrae, 60, 75; length of hind foot, 122, 118; length of ear from notch, 79, 73. External measurements of an adult male and adult female from Mokp'o are, respectively: Length of head and body, 425, 448; length of tail, 50, 51; length of hind foot, 108, 115; length of ear from notch, 76, 79. For cranial measurements see Table 1.

Remarks.—*Lepus coreanus* was originally described by Thomas as a subspecies of *Lepus sinensis,* although at the time he remarked that it might be necessary, upon the acquisition of additional material, to elevate it to full specific rank. This he did in his next mention of Korean specimens (1907*a*:865). Subsequently, Ellerman and Morrison-Scott (1951:442) again relegated *coreanus* to subspecific status under *L. sinensis.*

We prefer for the present to retain *L. coreanus* as a distinct species, although we recognize its close relationship to *sinensis. L. coreanus* differs from *L. sinensis* (subspecies *sinensis* and *formosus*) as follows: Larger; pelage considerably heavier and more blackish dorsally; tail markedly longer; nasals broader in relation to length, much less attenuated anteriorly, rarely exceeding premaxillae anteriorly; auditory bullae slightly smaller; external auditory meatuses conspicuously larger, meatal tubes directed more upward and outward; anterior extension of basisphenoid much broader; mandible larger and heavier; teeth, especially incisors, larger. The two species resemble each other in the general size and configuration of the skull.

Lepus coreanus and *L. sinensis,* as now known, are allopatric, *sinesis* having been recorded in China only as far north as the provinces of Anhwei and Kiangsu (G. M. Allen, 1938:560).

TABLE 1.—CRANIAL MEASUREMENTS OF THREE SPECIES OF LEPUS

Catalogue number and sex	Occipitonasal length	Basal length	Zygomatic breadth	Breadth across auditory meatuses	Length of nasals	Postorbital breadth	Length of incisive foramina	Length of maxillary tooth-row
Lepus coreanus, 8 mi. NE Seoul, Korea								
USNM 299507, ♀	82.6	68.3	40.7	32.8	33.9	12.6	20.1	17.0
Sangbonch'on-ni, Korea								
UMMZ 102434, ?	84.4	69.0	40.3	33.7	35.7	12.7	20.8	16.5
Suwon, Korea								
MCZ 43389, ♂	85.5	67.6	41.6	34.0	35.9	12.3	19.6	16.6
Ulsan, Korea								
AMNH 33962, ?	84.6	67.2	41.0	33.8	35.3	12.9	19.6	16.9
AMNH 33963, ♀	82.0	67.0	40.4	....	33.0	11.8	19.5	16.4
AMNH 34109, ♀	85.5	69.8	40.8	33.7	35.7	13.1	20.6	16.0
Lepus sinensis sinensis, Yochow, China								
USNM 239587, ♀	87.7	68.4	39.0	32.1	40.1	10.2	20.4	16.4
USNM 239588, ♂	84.2	67.0	41.0	32.1	38.6	11.3	19.8	16.2
USNM 239589, ♂	83.8	66.6	39.4	32.1	37.7	10.1	19.5	15.5
Shanghai, China								
USNM 239772, ♂	83.5	64.2	40.0	30.8	38.1	13.4	20.4	16.6
Lepus sinensis formosus, 6 mi. S Tungshi, Formosa								
USNM 294180, ♀	84.0	66.1	36.8	30.6	37.4	10.1	21.2	15.2
USNM 294182, ♀	84.6	64.5	37.6	30.2	38.7	10.2	20.5	15.4
USNM 294184, ♀	84.0	67.4	37.8	30.6	37.7	10.1	21.4	15.4
Lepus mandshuricus, Imienp'o, N. Kirin, Manchuria								
USNM 199678, ♂	92.1	76.0	44.8	34.3	40.4	11.3	22.5	18.1

Records of occurrence.—Specimens examined, 16, as follows: Mokp'o, 2 (YI); Pusan, 1 (USNM 194242); Sangbonch'on-ni, 125 m., 1 (UMMZ 102434); Seoul, 1 (BM 91.10.14.8, the holotype); 6 mi. E Seoul, 45 m., 1 (USNM 299506); 8 mi. NE Seoul, 65 m., 1 (USNM 299507); Suwon, 1 (MCZ 43389); Taegu, 500 ft., 2 (BM 6.12.6.111-12); Tumen River, Korean-Manchurian border, 3 (BM 1938.8.8.17-19); Ulsan, 3 (AMNH 33962-63, 34109).

Additional records: Central National Forest (Jones and Barber, 1957:380); Chiri-san (Won, 1961:43); Koryo [= Kwangnung] (Kuroda, 1938:44); Sorak-san, about 500 m. (Won, 1961:43).

Lepus mandshuricus Radde

Manchurian Hare

Lepus mandshuricus Radde, Melang. Biol., Imp. Acad. Sci. St. Petersbourg, 3:684, May, 1861. Type locality: Bureja Mountains, eastern Siberia.

Kuznetzov (*in* Bobrinsky *et al.*, 1944:273) and Loukashkin (1943: 79) reported this hare from Korea but listed no actual records.

There are several museum specimens that we think may represent this species but because they are not at hand as we write, or because they are incomplete specimens, we are unable to identify them with certainty.

Kuroda (1934:230) reported as *Lepus coreanus* a specimen obtained on July 3, 1929, at Riugan-po [=Yongamp'o] at the mouth of the Yalu River in extreme northwestern Korea. One of us (Jones) examined this specimen in the Yamashina Institute for Ornithology and Zoology, Tokyo, Japan, in 1954. External measurements of the specimen (a male) are: Length of head and body, 470; length of tail, 110; length of hind foot, 115; length of ear from notch, 82. The occipitonasal length of the uncleaned skull is 94.0 mm. These large dimensions (especially length of tail) and the dark coloration of the upper parts and tail lead us to refer this specimen provisionally to *L. mandshuricus.*

Allen and Andrews (1913:429) reported as *Lepus coreanus* four specimens from northeastern Korea that also may represent *L. mandshuricus.* Unfortunately the two specimens (AMNH 33960-61) from Mosan [= Musan] and the one (AMNH 33959) from Chunkang-chin [= Chunggangjin] are "hunter's skins" lacking skulls and measurements, and the single specimen (AMNH 34110) from Potai-dong is "a young one a few days old." The "hunter's skins" average darker dorsally than specimens of *coreanus* that we have seen, due to a heavier suffusion of blackish and less of an ochraceous wash. The skull of the young hare resembles that of *mandshuricus* in the broad nasals and in the distinctive configuration of the palatal bridge and mesopterygoid fossa.

ORDER RODENTIA—Rodents

Rodents are the most abundant of Korean mammals, both in number of kinds and number of individuals. Fifteen species of three families are known certainly to occur in the country.

G. M. Allen (1940:1071) erroneously listed a specimen (MCZ 20589) of *Allactaga sibirica sibirica* from Korea (see also Ellerman and Morrison-Scott, 1951:528). Actually, the specimen originated from Jehol, as Allen correctly noted on p. 1068 and as confirmed by Barbara Lawrence (*in litt.*) of the Museum of Comparative Zoology.

Family Sciuridae—Squirrels and Allies

Sciurus vulgaris coreae Sowerby

Palearctic Squirrel

Sciurus vulgaris coreae Sowerby, Ann. Mag. Nat. Hist., ser. 9, 7:252, March, 1921. Type locality: Kaloguai, 55 mi. NE Seoul, 500 ft., Korea.

Sciurus vulgaris coreanus, Mori, Catalogue of . . . the natural history of Chosen [Mammalia], p. 26, 1923. *Nomen nudum*—see also Kishida (1924:153) and Kishida and Mori (1931:378).

Distribution in Korea.—Entire peninsula in suitable habitats.

Measurements.—External measurements of an adult male and two young adults, male and female, from west-central Korea are, respectively: Total length, 442, 395, 414; length of tail-vertebrae, 192, 183, 194; length of hind foot, 70, 67, 70; length of ear from notch, 35, 34, 35. Cranial measurements of three adults, two males and a female, from west-central Korea are, respectively: Occipitonasal length, 54.5, 54.6, 55.2; basal length, 46.4, 46.6, —; zygomatic breadth, —, 32.8, 32.6; mastoid breadth, 24.9, 24.7, —; length of nasals, 18.4, 17.4, 18.0; postorbital breadth, 17.8, 17.9, 19.0; depth of skull, 24.3, 23.7, 25.3; length of upper molariform tooth-row, 10.5, 9.8, 10.2.

Remarks.—From *Sciurus vulgaris mantchuricus*, which is geographically adjacent to the north, *S. v. coreae* differs in being slightly smaller, both externally and cranially, paler dorsally (in summer pelage less blackish, in winter pelage less grayish), and in having a narrower skull posterior to the zygomatic arches. The holotype of *S. v. coreae* is a young animal (deciduous P3-4 still in place) and adult specimens available to us are somewhat larger in both external and cranial dimensions.

We found the Palearctic squirrel uncommon in the central part of Korea, perhaps owing to the depletion of the mixed and deciduous forests that once covered much of the central and southern parts of the peninsula, but the species evidently is common in some forested areas in what is now the Republic of South Korea (Won, 1961:43). The subspecies *coreae* has been reported from as far north as southern Manchuria (Sowerby, 1921:252-253 and 1923: 147).

Records of occurrence.—Specimens examined, 14, as follows: Central National Forest, near Pup'yong-ni, 200 m., 2 (USNM 299080, 302910); Kaloguai, 55 mi. NE Seoul, 500 ft., 2 (BM 7.6.3.16-17, including the holotype); 5 mi. N Pusan, 1 (MVZ 119815); Seoul, 6 (BM 91.10.14.6-7; USNM 193980-83); 32 mi. NE Seoul, 1 (USNM 283633); 3 mi. SSE Sumil-li, 1050 m., 2 (KU 63835; USNM 299081).

Additional records: Chiri-san, about 1200 m. (Won, 1961:43); Koyang-gun, near Seoul (Kuroda, 1917:358); Kumgang-san (Kishida, 1936:137); Kwangnung (Won, 1961:43).

Eutamias sibiricus

Asiatic Chipmunk

In central Korea the Asiatic chipmunk is most common on scrub-covered hillsides and in forested and mountainous areas. Locally it seems to prefer rocky outcroppings, chiefly granite, where homesites frequently are located. *E. sibiricus* is a rapid and agile climber and individuals spend considerable time in shrubs and trees. The breeding season evidently is restricted to late winter and early spring (two-thirds grown young were obtained on April 14, 1954,

and lactating females on April 18 and May 13, 1954). In the vicinity of Seoul chipmunks generally are inactive in the coldest parts of the year, but individuals were seen foraging on some warm days in the winter of 1954-55.

Allen and Andrews (1913:432) reported this species to be "by far the most abundant of all the small mammals of northern Korea."

Eutamias sibiricus barberi Johnson and Jones

Eutamias sibiricus barberi Johnson and Jones, Proc. Biol. Soc. Washington, 68:175, December 31, 1955. Type locality: Central National Forest, near Pup'yong-ni (37° 44′ N, 127° 12′ E), Korea.

Distribution in Korea.—Central and southern parts.

Measurements.—Average and extreme external and cranial measurements of ten adults from the type locality (one male and nine females, including the holotype) are: Total length, 270.7 (261-285); length of tail-vertebrae, 117.3 (102-129); length of hind foot, 37.7 (35-40); length of ear from notch, 18.2 (17-19.5); occipitonasal length, 40.8 (39.9-42.0); basal length, 33.4 (33.2-34.1); zygomatic breadth, 22.2 (21.7-22.8); mastoid breadth, 17.8 (17.5-18.2); postorbital breadth, 11.5 (10.8-12.3); length of nasals, 13.3 (12.5-14.4); depth of skull, 15.5 (15.2-15.9); length of maxillary tooth-row, 6.5 (6.2-6.8). Weights in grams of nine adults, five males and four non-pregnant females, all from the type locality and all taken in spring or summer, are, respectively: 104.0, 85.1, 91.4, 97.0, 99.0, 100.7, 91.2, 96.8, and 120.0.

Remarks.—From *Eutamias sibiricus orientalis,* geographically adjacent to the north in Korea, *E. s. barberi* differs as follows: Upper parts and sides, in general, more ochraceous; rump more rufous; dark dorsal stripes less distinct; underside of tail brighter ochraceous; skull slightly larger and more robust; dorsal outline of skull more rounded in lateral profile; rostrum more down-curved and averaging broader; upper incisors less procumbent; roof of skull in postorbital region averaging broader; auditory bullae smaller. We have seen no specimens from north-central Korea where we would expect intergradation between *barberi* and *orientalis* to take place.

From the type specimen of *Eutamias sibiricus senescens* from 15 miles west of Peking, China, specimens of *E. s. barberi* differ in: Upper parts, in general, more ochraceous; dark dorsal stripes more distinct; rump decidedly more rufous; feet and underside of tail brighter ochraceous; skull narrower, especially across rostrum and zygomatic arches; nasals averaging shorter; upper incisors more recurved; upper molariform teeth smaller.

E. s. barberi is a well-marked subspecies of *Eutamias sibiricus.* Some of the characters separating it from geographically adjacent subspecies are as obvious as those that separate full species of the genus *Eutamias* in western North America.

Of 41 skulls of this subspecies available to us for study, two (an adult female from the Central National Forest and an adult male

from three miles south-southeast of Sumil-li) lack the P3 on both sides; this tooth is reduced in size in some other specimens (see Jones, 1960:268-269).

Records of occurrence.—Specimens examined, 74, as follows: Central National Forest, near Pup'yong-ni, 26 (KU 60404-09, 67230; UMMZ 99587; USNM 298040-48, 299084-87, 299582, 301239-41, 301243, 302911, including the holotype); Changjon, 500-2000 ft., 5 (YI); 1 mi. N Chinbu-ri, 400 m., 1 (USNM 298945); 4 mi. N Chip'o-ri, 150 m., 1 (USNM 298946); Ch'ongyang-ni, 1 (USNM 298039); Kaloguai, 55 mi. NE Seoul, 500 ft., 1 (BM 7.6.3.23); Kyonggi Prov., 4 (MCZ 37696-99); Kumhwa, 65 mi. NE Seoul, 300 ft., 4 (BM 7.6.3.19-22); Kuksa-bong, 1 (USNM 298049); Nam-san, near Seoul, 4 (MVZ 118567, 118954, 119709-10); Pusan, 1 (USNM 60391); Sangbonch'on-ni, 1 (USNM 298944); Seoul, 12 (CMNH 11283-89; MCZ 43398; USNM 283634, 299599-600, 300448); Songu-ri, 3 (USNM 294632, 298037-38); 3 mi. SSE Sumil-li, 1050-1440 m., 7 (USNM 298947, 299082-83, 299583, 301242, 301909-10); central Korea, 1 (USNM 301911).

Additional records (Won, 1961:44, unless otherwise noted): Ch'angch'on; Chiri-san; Ch'ongyang-ri (Won and Woo, 1961:120); Inch'on; Kwangnung, near Seoul, 300 ft. (Kuroda, 1917:359); Sorak-san; Sosa; Toktun-ni (Lawrence and Harriss, MS).

Eutamias sibiricus orientalis (Bonhote)

Tamias orientalis Bonhote, Ann. Mag. Nat. Hist., ser. 7, 4:385, November, 1899. Type locality: Sungatscha River, upper Ussuri River, eastern Siberia.

Eutamias sibircus orientalis, Ognev, The mammals of the USSR and adjacent countries, 4:487, 1940.

Distribution in Korea.—Known only from extreme northern part.

Measurements.—Average and extreme external and cranial measurements of six adults (three males and three females) from the vicinity of Nongsa-dong are: Total length, 257.7 (247-270); length of tail-vertebrae, 102.5 (98-110); length of hind foot, 38.2 (37-39); occipitonasal length, 39.9 (38.7-40.7); basal length, 33.7 (33.0-34.6); zygomatic breadth, 22.5 (22.3-23.0); mastoid breadth, 17.9 (17.7-18.4); postorbital breadth, 10.4 (9.6-11.2); length of nasals, 13.1 (12.7-13.8); depth of skull, 15.0 (14.6-15.3); length of maxillary tooth-row, 6.5 (6.4-6.9).

Remarks. — For comparisons with *Eutamias sibiricus barberi,* which is geographically adjacent to the south, see the account of that subspecies. From the holotype of *Eutamias sibiricus senescens* from 15 miles west of Peking, China, Korean specimens of *E. s. orientalis* differ as follows: Upper parts more ochraceous in general aspect; skull smaller and less massive, its dorsal outline less rounded in lateral profile; rostrum much narrower, nasals averaging shorter.

A specimen from 120 miles up the Yalu River has a deeper skull that is more rounded in lateral profile and a somewhat richer coloration than specimens from northeastern Korea, approaching *E. s. barberi* in these particulars.

The subgenus *Eutamias* is in need of revisionary study. We tentatively refer our North Korean material to *E. s. orientalis,* the type locality of which is not far from the northeastern corner of

Korea, but we have examined no topotypes of that subspecies. Russian authors (Ognev, 1940:487, Kuzentzov, *in* Bobrinsky *et al.*, 1944:282, and others) have recognized the subspecies *orientalis* as occurring in extreme southeastern Siberia and in adjacent parts of Manchuria and Korea. Ellerman and Morrison-Scott (1951:503) regarded *orientalis* as a synonym of *E. s. asiaticus.*

Records of occurrence.—Specimens examined, 32, as follows: P'ungsan-dong, 2 (AMNH 34004-05); Musan, 2 (AMNH 34006; BM 13.5.27.46); Nongsa-dong, 22 (AMNH 33986-95, 33998-99; BM 13.5.27.43-44; MCZ 15286-87; YI-6 specimens); 18 mi. SW Nongsa-dong, 3 (AMNH 33996, 34000-01); Pochong, 1 (AMNH 34002); Potai-dong, 1 (BM 13.5.27.45); 120 mi. up Yalu River, 100 ft., 1 (USNM 199632).

Petaurista leucogenys hintoni Mori

Giant Flying Squirrel

Petaurista leucogenys thomasi Kuroda and Mori, Jour. Mamm., 4:27, February 9, 1923. Type locality: Seoul, Korea. Not *Petaurista thomasi* Hose, 1900.

Petaurista leucogenys hintoni Mori, Jour. Mamm., 4:191, August 10, 1923 (substitute name for *thomasi*).

Distribution in Korea.—Known only from the type locality.

Measurements (after Kuroda and Mori, 1923:27).—"Head and body, 475 ± mm.; tail, 235 mm.; hind foot, 59 mm. (measured on the skin)."

Remarks.—We view with some doubt the report of the occurrence of flying squirrels of the genus *Petaurista* in Korea. The holotype of *P. l. hintoni*, the only known specimen of the subspecies, was purchased without skull at the "Seoul game-market" in 1920. It could easily have been imported from the Japanese islands or from elsewhere in Asia. It seems to us that such a large and unusual rodent as *Petaurista* would certainly, where it occurred, be well known to the natives and that if it actually inhabited Korea its occurrence there would have been reported elsewhere in the literature. The only other record of the genus on the Asiatic mainland north of central China is the holotype of *Petaurista watasei*, also described by Mori (1927:107), which was obtained in a market in Mukden, Manchuria.

Another genus of large flying squirrel, *Aeretes*, is known as far north as the vicinity of Peking, China, but the external measurements listed for *P. l. hintoni* are quite different (head and body much longer, tail much shorter) from those listed for *Aeretes melanopterus* by G. M. Allen (1940:747).

The holotype of *P. l. hintoni* evidently was destroyed at Seoul in the Korean hostilities of the early 1950's.

Pteromys volans

Palearctic Flying Squirrel

This small flying squirrel evidently is uncommon in Korea. Won (1961:44) noted that it is "met with only in heavy forests." Only five specimens have been obtained from the peninsula.

Pteromys volans aluco (Thomas)

Sciuropterus aluco Thomas, Proc. Zool. Soc. London, 1907: 464, October 9, 1907. Type locality: Kaloguai, 55 mi. NE Seoul, 500 ft., Korea.

Pteromys volans aluco, Ellerman, The families and genera of living rodents, 1:294, June 8, 1940.

Distribution in Korea.—Known only from the type locality and from Ch'onma-san; probably occurs in forested areas throughout southern and central Korea.

Measurements.—External and cranial measurements of the holotype, a female, are: Length of head and body, 157; length of tail, 149; length of hind foot, 35; length of ear from notch, 19.5; occipitonasal length, 38.4; palatal length, 18.8; zygomatic breadth, 22.4; interorbital breadth, 7.3; length of nasals, 12.4; breadth of braincase, 17.3; length of incisive foramina, 4.9; length of maxillary tooth-row, 6.8.

Remarks.—In comparison with specimens from northeastern Korea that we have referred tentatively to *Pteromys volans arsenjevi,* the holotype of *P. v. aluco* differs in being somewhat larger and in having slightly darker (less reddish) upper parts, which approach those of the Japanese *P. momonga,* and a longer tail that is darker on the ventral surface. We have been unable to compare skulls of the two subspecies. Externally, *P. v. aluco* resembles *P. momonga,* but is arranged as a subspecies of *volans* on the basis of cranial characters (see Ellerman, 1949:12-13).

Records of occurrence.—Specimen examined, one, the holotype (BM 7.6.3.18).
Additional record: Ch'onma-san (Won, 1961:44).

Pteromys volans arsenjevi Ognev

Pteromys volans arsenjevi Ognev, Bull. Soc. Nat. Moscou, 43 (for 1934):309 (Russian) and 314 (English), 1935. Type locality: "sources of the riv. Kulume, Ussuri region," Siberia.

Distribution in Korea.—Presently known only from northeastern part.

Measurements.—External measurements of two adults, a male and female, from Nongsa-dong are, respectively: Length of head and body, 147, 153; length of tail, 115, 108; length of hind foot, 35, 33; length of ear from notch, 17, 17. No cranial measurements are available for Korean specimens.

Remarks.—We provisionally assign three specimens from extreme northeastern Korea to *arsenjevi* because they essentially agree with the description of that subspecies as concerns external measurements and coloration. Final allocation of these specimens must

await the availability of additional material from Korea, Manchuria, and southeastern Siberia. The remarkable difference in length of tail between the three specimens and the holotype of *aluco* suggests the possibility that two distinct species of small flying squirrels inhabit the mainland of northeastern Asia.

Records of occurrence.—Specimens examined, 3, as follows: Nongsa-dong, 6000 ft., 2 (YI); Tumen River, Korean-Manchurian border, 2500 ft., 1 (BM 1938.8.8.10).

Family Cricetidae—Cricetids

Cricetulus barabensis fumatus Thomas

Striped Hamster

Cricetulus griseus fumatus Thomas, Ann. Mag. Nat. Hist., ser. 8, 4:503, December, 1909. Type locality: Chu-chia-t'ai, near Ch'ang-ch'un, Kirin Prov., Manchuria.

Cricetulus barabensis fumatus, Chaworth-Musters, Ann. Mag. Nat. Hist., ser. 10, 12:223, August, 1933.

This species has been reported only from Sinuiju (Won, 1961:46), but probably will be found to occur elsewhere in the northwestern part of Korea. We have seen no specimens.

Cricetulus triton nestor Thomas

Long-tailed Hamster

Cricetulus nestor Thomas, Proc. Zool. Soc. London, 1907:466, October 9, 1907. Type locality: Kim-hoa [=Kumhwa], 65 mi. NE Seoul, 300 ft., Korea.

Cricetulus triton nestor, Howell, Proc. U. S. Nat. Mus., 75:50, June 7, 1929.

Asiocricetus bampensis Kishida, Lansania, 1:150, December 21, 1929. Type locality: Bampo [=Manp'o], 50 ft., Korea.

Asiocricetus yamashinai Kishida, Lansania, 1:156, December 21, 1929. Type locality: Bampo [=Manp'o], 50 ft., Korea.

Distribution in Korea.—Entire peninsula in suitable habitats; also on Cheju Do.

Measurements.—Average and extreme external measurements of 10 adults (four males, six females) from central Korea are: Total length, 250.6 (240-268); length of tail-vertebrae, 84.7 (75-91); length of hind foot, 25.2 (23-27); length of ear from notch, 21.4 (20-25). For cranial measurements see Table 2. An adult female (non-pregnant) from 4½ mi. W Chip'o-ri weighed 99.8 grams.

Remarks.—The two specimens examined from Cheju Do differ in several cranial features from topotypes and other specimens of *C. t. nestor* from central Korea, especially in having a narrower skull, less well-developed supraorbital ridges, more evenly rounded bullae, shorter incisive foramina, and paler anterior surfaces on the upper incisors. When additional specimens are available from Cheju Do, we suspect that the insular population will prove to be subspecifically distinct from that on the adjacent mainland.

TABLE 2.—CRANIAL MEASUREMENTS OF CRICETULUS TRITON NESTOR

Catalogue number or number of specimens averaged, and sex	Occipitonasal length	Zygomatic breadth	Interorbital constriction	Length of nasals	Rostral breadth	Length of incisive foramina	Depth of skull	Length of maxillary tooth-row
Central Korea								
Average 6 (3 ♂, 3 ♀)	39.6	20.9	5.8	14.1	8.1	7.9	14.4	5.7
Minimum	38.3	20.0	5.5	13.4	7.7	7.2	13.9	5.5
Maximum	41.9	22.5	5.9	14.8	8.5	8.7	14.8	6.0
Vicinity Mosulp'o, Cheju Do, Korea								
USNM 299227, ♂	40.3	19.5	5.4	15.4	7.5	7.0	14.5	5.9
USNM 305964, ♀*	37.2	18.9	5.3	13.1	7.6	6.9	13.3	5.9
150 mi. up Yalu River, Korea								
USNM 199624, ♀	40.8	22.3	5.3	14.5	8.0	7.1	14.5	5.5
USNM 199625, ♀*	36.7	19.4	5.4	13.0	7.6	6.6	13.4	5.5

* Young adult.

We follow Kuroda (1934:231-232 and elsewhere) in regarding *Asiocricetus bampensis* and *A. yamashinai,* both named by Kishida (1929) from Manp'o, Korea, as synonyms of *C. t. nestor.* Specimens from northern Korea (Manp'o, Nongsa-dong, Yalu River) average smaller in some measurements than specimens of *nestor* from central Korea and approach *C. t. triton* in this regard. Future taxonomic consideration of long-tailed hamsters from northern Korea and adjacent regions must take into account the first of Kishida's names (*bampensis*) as well as *Tscherskia albipes* Ognev, 1914 (type locality, bank of River Tumen-Lau, southern Primorsk, Siberia), which, like *bampensis,* is currently regarded as a synonym of *C. t. nestor* (see Ellerman and Morrison-Scott, 1951:626).

Dry hillsides covered with grass or scrub seemingly provide the preferred habitat of this hamster in central Korea. Specimens were obtained also in agricultural areas and occasionally in grassy lowlands; Won (1961:46) recorded the species as occurring also in forested areas. Loukashkin (1944:173) reported that *C. triton* breeds in spring in Manchuria and that females have 4 to 6 young per litter. We obtained pregnant or lactating females in central Korea in late June and in August, and juveniles in October.

Records of occurrence.—Specimens examined, 82, as follows: Chip'o-ri, 1 (USNM 294633); 3 mi. NW Chip'o-ri, 145 m., 1 (KU 60434); 4½ mi. W Chip'o-ri, 155 m., 1 (USNM 299088); Ch'ongyang-ni, 1 (USNM 298060); Ch'onsong-ni, 2 (USNM 294634, 298061); 5 mi. S Ch'orwon, 1 (USNM

299089); Hant'anch'on Valley, approximately 7 mi. ESE Yonch'on, 2 (UMMZ 102517-18); Kumhwa, 20 (BM 7.6.3.50-52, including the holotype; CM—1 specimen; USNM 294635-43, 298050-54; YI 117-118); Manp'o, 10-50 ft., 10 (YI 60, 63, 69, 70, 73, 75, 78, 79, 82, 83); Mosulp'o, Cheju Do, 1 (USNM 305964); 1 mi. N Mosulp'o, 10 m., Cheju Do, 1 (USNM 299277); 7 mi. SSE Munsan-ni, 1 (USNM 302912); Nongsa-dong, 6 (AMNH 34044-46, 34073-75); Ori-dong, 5 (USNM 298055-57, 299601; UMMZ 99588); 6 mi. E Seoul, 45 m., 11 (KU 60436, 63836-38; USNM 298948, 299092-94, 299508, 299602, 300648); 2 mi. E Songdong-ni, 95 m., 2 (USNM 299090-91; Songu-ri, 1 (USNM 298062); Taehoesan-ni, 180 m., 1 (KU 60435); Yangwon-ni, 1 (USNM 301244); 150 mi. up Yalu River, 7 (USNM 199624-30); Yongp'yong, 1 (USNM 301245); Yonch'on, 3 (USNM 298058-59, 301246); central Korea, 2 (USNM 301919-20).

Additional records: Anju (Kuroda, 1940:115); Seoul, (Tokuda, 1941:37); Toktun-ni (Lawrence and Harriss, MS).

Clethrionomys rufocanus

Eurasian Red-backed Vole

This red-backed vole is fairly common in central Korea, where individuals are trapped most frequently on scrub-covered hillsides, on talus slopes, and in forested areas. Near Oho-ri, however, it was obtained along paddy dikes within several hundred feet of the Sea of Japan, and individuals occasionally were taken in abandoned paddy fields and other lowland habitats elsewhere in central Korea. The species usually was associated with *Apodemus peninsulae peninsulae.*

The breeding season extends from late March to October. Females may give birth to several litters per year and have 3 to 6 young per litter.

In northern Korea, *C. rufocanus* is sympatric with another species of red-backed vole, *C. rutilus.* The two kinds resemble each other externally, but in winter pelage *rutilus* is brighter rufous on the head and back, thus having a sharper contrast between back and the grayish ochraceous sides, is less grayish ventrally, and has a more pilose and more strikingly bicolored tail. They are readily distinguished by cranial characters in that *C. rutilus* has a narrower skull than *C. rufocanus,* smaller auditory bullae, smaller teeth, and distinctly shorter molariform tooth-rows (less than 5.5 mm. in *rutilus,* more than 6.0 in *rufocanus*). Also, adults of *rutilus* have rooted cheek-teeth, whereas those of *rufocanus* do not (see Jameson, 1961).

Clethrionomys rufocanus arsenjevi (Dukelski)

Evotomys (*Craseomys*) *arsenjevi* Dukelski, Zool. Anzeiger, 77:40, May 15, 1928. Type locality: Stekljannaja Padj, 75 versts [= approximately 50 mi.] NE Vladivostok, Siberia.

Clethrionomys rufocanus arsenjevi, Goodwin, Amer. Mus. Novit., 681:12, December 30, 1933.

Distribution in Korea.—Known only from extreme northeastern part.

Measurements.—Average and extreme external measurements of four adults, one male and three females, from extreme northeastern Korea, are: Total length, 153.2 (151-155); length of tail-vertebrae, 36.0 (34-39); length of hind foot, 19.7 (19-20). For cranial measurements see Table 3.

Remarks.—For comparison with *Clethrionomys rufocanus regulus*, geographically adjacent to the south, see account of that subspecies.

We tentatively refer specimens from northeastern Korea to *C. r. arsenjevi*. We have seen no topotypes of *arsenjevi* but our material seems to fit the description of that subspecies and the type locality is not far distant from the localities whence our specimens from northeastern Korea originated. Ognev (1950:105) regarded *arsenjevi* as a synonym of *C. r. irkutensis*, Kuznetzov (*in* Bobrinsky *et al.*, 1944:346) regarded it as a synonym of *C. r. bedfordiae* of the island of Hokkaido, Japan, and Ellerman and Morrison-Scott (1951:666) erroneously listed both *arsenjevi* and *bedfordiae* as synonyms of "*Clethrionomys rufocanus smithii*" (Jameson, 1961). Korean specimens examined differ from *C. r. bedfordiae* from Hokkaido in hav-

TABLE 3.—CRANIAL MEASUREMENTS OF TWO SPECIES OF CLETHRIONOMYS

Catalogue number and sex	Occipitonasal length	Condylobasal length	Palatal length	Zygomatic breadth	Breadth across auditory bullae	Interorbital breadth	Length of nasals	Length of incisive foramina	Length of maxillary tooth-row
Clethrionomys rufocanus arsenjevi, Potai-dong, Korea									
USNM 197977, ♂	26.8	26.2	13.8	15.2	12.8	3.9	7.6	5.4	6.6
AMNH 34009, ♂	25.6	25.3	13.3	14.3	12.6	3.8	7.6	5.1	6.5
USNM 197976, ♀	25.6	25.5	13.2	14.4	12.2	3.7	7.6	5.1	6.7
Clethrionomys rufocanus regulus, central Korea									
USNM 294649, ♂	27.3	27.2	14.2	15.5	12.8	4.6	8.1	5.6	6.5
USNM 298064, ♂	26.4	25.9	13.2	15.0	12.5	4.3	7.7	5.2	6.4
USNM 298065, ♂	27.2	27.0	13.9	15.8	13.2	4.5	8.2	5.6	6.2
USNM 298068, ♀	25.6	25.3	13.3	14.8	12.3	4.2	7.4	5.4	6.1
USNM 300646, ♀	26.3	26.2	13.6	14.9	12.8	4.5	7.8	5.2	6.3
120–150 mi. up Yalu River, Korea									
USNM 199639, ♀	25.6	25.4	13.4	14.9	12.6	4.2	7.6	5.2	6.3
USNM 199642, ♀	25.9	25.6	13.6	15.3	12.9	4.2	8.0	5.1	6.2
USNM 199665, ♀	25.8	25.4	13.5	14.7	12.6	4.1	8.0	5.5	6.3
Clethrionomys rutilus hintoni, vicinity Nongsa-dong, Korea									
AMNH 34027, ♂	26.2	25.2	13.0	14.1	12.4	4.0	8.0	5.6	5.4
AMNH 34034, ♀	24.6	24.4	12.8	13.8	12.0	4.1	7.3	5.3	5.2

ing slightly more reddish upper parts, a much shorter tail, a smaller and less massive skull, relatively broader and more bowed zygomatic arches, and longer incisive foramina.

The type locality of *C. r. arsenjevi* is listed in the original description as "Stekljannaja Padj, 75 Werst nordostl. von Wladiwostok, Ussuri-Gebiet." On another page of the same paper, Stekljannaja Padj is listed as the type locality of "*Mus* (*Alsomys*) *major rufulus*" but is there located as "75 Werst sudostlich von Wladiwostok." We have been unable to locate Stekljannaja Padj on any maps available to us.

Records of occurrence.—Specimens examined, 24, as follows: Nongsa-dong, 1 (AMNH 34029); 13½ mi. SW Nongsa-dong, 7 (AMNH 34023, 34030, 34035, 34038-40; BM 13.5.27.55); 18 mi. SW Nongsa-dong, 1 (AMNH 34036); 43 mi. SW Nongsa-dong, 1 (AMNH 34037); Pochong, 4 (AMNH 34016-18; BM 13.5.27.56); Potai-dong, 9 (AMNH 34007, 34009, 34011, 34015; BM 13.5.27.53-54; MCZ 15792; USNM 197976-77); Tumen River, Korean-Manchurian border, 2500 ft., 1 (BM 1938.8.8.16).

Additional record: Kwanmo-bong, 2000 m. (Tokuda, 1941:134).

Clethrionomys rufocanus regulus (Thomas)

Craseomys regulus Thomas, Proc. Zool. Soc. London, 1906:863, April 11, 1907. Type locality: Min-gyong [= Mun'gyong], 110 mi. SE Seoul, 1000 ft., Korea.

Clethrionomys rufocanus regulus, Howell, Proc. U. S. Nat. Mus., 75:51, June 7, 1929.

Distribution in Korea.—Entire peninsula except extreme northeastern part.

Measurements.—Average and extreme external measurements of 10 adults (four males, six females) from central Korea are: Total length, 154.5 (150-161); length of tail-vertebrae, 46.6 (42-51); length of hind foot, 19.3 (18-20.5); length of ear from notch, 14.3 (13-15). For cranial measurements see Table 3.

Four adult males and three non-pregnant females from west-central Korea weighed 36.4, 29.0, 26.6, 22.8, 38.5, 30.7, and 23.0 grams, respectively.

Remarks.—From specimens provisionally referred to *Clethrionomys rufocanus arsenjevi* from northeastern Korea, *C. r. regulus* differs as follows: Upper parts, in comparable pelages, conspicuously brighter; underparts more buffy (less grayish); tail noticeably longer; skull averaging larger; rostrum and interorbital region much broader; molariform tooth-rows shorter; auditory bullae larger. The geographic range of *C. r. regulus* evidently extends into southwestern Manchuria and Jehol (Kuroda, 1939:21).

Records of occurrence.—Specimens examined, 83, as follows: Central National Forest, near Pup'yong-ni, 3 (UMMZ 99593; USNM 298068, 300646); Changjon, 300 ft., 2 (YI); Chip'o-ri, 4 (USNM 294644-47); near Ch'ongju, 800 ft., 8 (BM 7.6.3.53-60); Ch'onsong-ni, 2 (USNM 298065-66); 3 mi. SE Ch'orwon, 1 (KU 67231); Hant'an-chon Valley, approximately 7 mi. ESE Yonch'on, 2 (UMMZ 102519-20); Kaloguai, 55 mi. NE Seoul, 500 ft., 1 (BM 7.6.3.62); Kumhwa, 6 (BM 7.6.3.61; USNM 294648-50, 298063-64); Mun'gyong, 110 mi. SE Seoul, 1000-1300 ft., 19 (BM 6.12.6.89-106, including the holotype; MVZ 30373); Oho-ri, 50 ft., 1 (UMMZ 102433); 1 mi. N Oho-ri,

1-2 m., 2 (USNM 298952, 298956); 1 mi. NW Oho-ri, 6 m., 3 (KU 60438-39; USNM 298953); Ori-dong, 1 (USNM 298067); near Pammol, 1 (USNM 301251); near Pusan, 1 (USNM 301535); 30 mi. N Pusan, 1 (USNM 298069); 5 mi. E Seoul, 1 (USNM 302914); 3 mi. SSE Sumil-li, 1468 m., 3 (USNM 299095, 301249-50); 10 mi. N Taegu, 1200 ft., 4 (BM 6.12.6.107-110); Taegwang-ni, 300 ft., 1 (USNM 298949); 1 mi. W Tangjonggok, 425 m., 2 (USNM 298954-55); Tongp'yonch'on, 1 (USNM 301248); 120 mi. up the Yalu River, 1 (USNM 199665); 150 mi. up the Yalu River, 5 (USNM 199638-42); 3 mi. SW Yanggu, 450 m., 2 (USNM 298950-51); 4 mi. NE Yanggu, 1 (NSMJ); Yonch'on, 1 (NSMJ); Yonggwang, 800 ft., 2 (YI); central Korea, 1 (USNM 301247).

Additional records (Jones, MS, unless otherwise noted): Anju (Kuroda, 1938:58); Ch'angch'on (Won, 1961:45); 3 mi. SW Chigyong-dong; vicinity Chinmokchong; Chiri-san (Won, 1961:45); Ch'orwon; Ch'unch'on; Kumgang-san (Tokuda, 1941:134); Nap'a-dong, 175 m.; Seoul (Tokuda, 1941:134); Soch'on-ni; Sorak-san (Won, 1961:45); Taehoesan-ni; 2 mi. S Tongduch'on-ni; Tongp'yongch'on; Wach'o-ri; 15 mi. NW Wonju (Jameson and Toshioka, 1954: 12); Yami-ri; Yongp'yong, 110 m. See also the map published by Won and Woo (1958c:5) that purports to show localities whence *C. rufocanus* has been reported from Korea. On that map the species is indicated as occurring at several localities that are not substantiated in any other published source, including Won's (1961:45) own subsequent list.

Clethrionomys rutilus hintoni Vinogradov

Northern Red-backed Vole

Clethrionomys rutilus hintoni Vinogradov, *in* Zolotarev, Mammals of the Iman River Basin, p. 81, 1936. Type locality: Iman River, Ussuri Region, southeastern Siberia.

Distribution in Korea.—Mountainous areas of northeastern part, south at least to Ch'ail-bong.

Measurements.—Average and extreme external measurements of four adults (two males, two females) from the vicinity of Nongsa-dong are: Total length, 148.2 (142-162); length of tail-vertebrae, 32.5 (31-34); length of hind foot, 19.2 (18-20). For cranial measurements see Table 3.

Remarks.—The Korean specimens of *C. rutilus* examined are only provisionally referred to the subspecies *hintoni* (type from the Iman River, southeastern Siberia), because we have been unable to study typical material. The Korean specimens at hand seem to fit the diagnosis of *hintoni* (as given by Kuznetzov, *in* Bobrinsky *et al.*, 1944:345), and the type locality is near northeastern Korea. Ognev (1950:141) regarded *hintoni* as a synonym of *C. r. amurensis* (type from mouth of the Amur River, near Nikolaevsk, eastern Siberia).

C. r. hintoni apparently is confined in Korea to the high mountainous areas of the northeastern part of the peninsula. The specimen reported by Mori (1939:3) from Mt. Shazitsuho [= Ch'ail-bong] has a slightly longer tail (40 mm.) than do the specimens from farther to the north.

As previously pointed out (Jones and Johnson, 1956), Allen and Andrews (1913:430) listed specimens of *C. rutilus* and *C. rufocanus* from northeastern Korea together under the name *"Craseomys*

regulus." We have examined 35 of the 37 specimens originally reported by them and among these find 23 that are referable to *C. rufocanus arsenjevi* and 12 that are referable to *C. rutilus hintoni.* Allen and Andrews (*op. cit.*:431) wrote of red-backed voles in the vicinity of Nongsa-dong as follows: "A large series was . . . trapped some little distance within the edge of the forest. . . . They were caught about old logs and tree stumps and often near the banks of small streams." These statements may apply equally well to either *rutilus* or *rufocanus,* as both species were obtained from all save one of the localities visited by Andrews in the vicinity of Nongsa-dong.

Records of occurrence.—Specimens examined, 12, as follows: 13½ mi. SW Nongsa-dong, 7 (AMNH 34024, 34031-32, 34034, 34041, 34043; MCZ 15293); 18 mi. SW Nongsa-dong, 3 (AMNH 34025, 34027, 34042); 43 mi. SW Nongsa-dong, 2 (AMNH 34022, 34026).

Additional records: Ch'ail-bong (Mori, 1939:3); Kwanmo-bong, 2000 m. (Tokuda, 1941:131).

Microtus fortis

Reed Vole

The reed vole was obtained in the central part of the Korean Peninsula for the first time in 1952. Individuals were trapped in lowland habitats, principally along the banks of streams and in abandoned paddies, in areas deserted by civilians at the onset of combat activities in 1950. Evidently the species does not long survive in areas where it is in direct competition with man because, insofar as we are aware, it does not occur in lowland habitats materially altered for agricultural purposes. Under conditions of intensive cultivation the species may exist, in central Korea at least, only in small, more or less isolated colonies, which possibly accounts for the fact that prior to 1952 it was known only from the extreme northeastern part of the country.

The breeding season extends from late March to mid-November. Many females give birth to several litters annually and have 3 to 7 young per litter.

Microtus fortis pelliceus Thomas

Microtus pelliceus Thomas, Ann. Mag. Nat. Hist., ser. 8, 7:383, April, 1911. Type locality: Ussuri River, southeastern Siberia.

M[icrotus]. f[ortis]. pelliceus, G. M. Allen, The mammals of China and Mongolia, 2:860, September 3, 1940.

Distribution in Korea.—Known only from two localities in extreme northeastern part.

Measurements.—External measurements of an adult male from Manp'o are: Length of head and body, 140; length of tail, 60; length of hind foot (without claw), 24; length of ear from notch, 14.5. External and cranial measurements

of an adult male and an adult female from the Sungari River, 60 mi. SW Kirin, Manchuria, are, respectively: Length of head and body, 147, 132; length of tail, 60, 53; length of hind foot (without claw), 23, 23; length of ear from notch, 15, 14; condylobasal length, 32.2, 31.9; occipitonasal length, 30.9, 31.3; palatal length, 19.1, 18.9; zygomatic breadth, 17.9, 17.6; breadth across auditory bullae, 14.8, 14.5; interorbital breadth, 4.2, 4.1; length of nasals, 8.7, 8.7; length of incisive foramina, 6.0, 6.4; length of maxillary tooth-row, 7.8, 8.3.

Remarks.—From *Microtus fortis uliginosus* of central Korea, *M. f. pelliceus* differs in: Upper parts, in general, less suffused with ochraceous and having a slightly darker and less olivaceous appearance; winter pelage longer and denser; underparts slightly darker and lacking faint buffy tinge; upper surfaces of hind feet wholly dark rather than paler on inner margins; tail averaging darker vertrally; skull smaller (especially in condylobasal, occipitonasal, and palatal lengths, and in zygomatic and interorbital breadths) and less massive; nasals less expanded anteriorly; infraorbital canals broader when viewed from the front; auditory bullae and cheek-teeth smaller.

Records of occurrence.—Specimens examined, 9, as follows: Manp'o, 9 (YI).

Additional record: Ranto (island), off Unggi (Kuroda, 1934:231).

Microtus fortis uliginosus Jones and Johnson

Microtus fortis uliginosus Jones and Johnson, Proc. Biol. Soc. Washington, 68:193, December 31, 1955. Type locality: Chip'o-ri (38°08′ N, 127°19′ E), Korea.

Distribution in Korea.—Known presently only from a restricted area in central Korea bounded by Kumhwa and Ch'orwon on the north and the 38th parallel of latitude on the south.

Measurements.—Average and extreme external and cranial measurements of five adult males, followed by those of five adult females (including the holotype), are, respectively: Total length, 207.8 (193-223), 207.0 (197-215); length of tail-vertebrae, 64.2 (57-70), 58.6 (55-62); length of hind foot, 24.4 (23-26), 24.2 (21-27); length of ear from notch, 16.4 (15-18), 15.4 (14-17); condylobasal length, 34.4 (33.9-35.0), 33.3 (32.8-34.0); occipitonasal length, 33.1 (32.2-33.6), 32.6 (32.4-33.2); palatal length, 19.9 (19.5-20.2), 19.6 (19.2-20.2); zygomatic breadth, 18.7 (18.4-19.2), 18.7 (18.3-19.7); breadth across auditory bullae, 15.1 (14.6-15.4), 14.9 (14.5-15.6); interorbital breadth, 4.5 (4.3-4.7), 4.4 (4.4-4.5); length of nasals, 9.1 (8.5-9.6), 9.1 (8.7-9.5); length of incisive foramina, 6.3 (5.9-6.5), 6.0 (5.7-6.3); length of maxillary tooth-row, 8.4 (8.1-8.7), 8.3 (7.9-9.0).

An adult male from Taegwang-ni weighed 81.7 grams and a pregnant female from Yongp'yong 67.6 grams.

Remarks.—For comparison with *Microtus fortis pelliceus* of extreme northeastern Korea see the account of that subspecies. The known geographic range of *M. f. uliginosus* is nearly 400 miles south of the most southerly record of occurrence of *M. f. pelliceus.*

Records of occurrence.—Specimens examined, 95, as follows: Chip'o-ri 150 m., 52 (KU 60442, 63839-41, 67233; UMMZ 99529; USNM 294651-59, 294661-63, 298070-89, 298958, 299509-15, 300647, 301252-53, 301256, 301912,

301915, including the holotype); 1½ mi. NW Chip'o-ri, 140 m., 1 (KU 60437); 2 mi. N Chip'o-ri, 150 m., 1 (USNM 298959); 3 mi. NW Chip'o-ri, 145 m., 6 (KU 60443; USNM 298961-63, 299096-97); Ch'ongyang-ni, 9 (CM—1 specimen; USNM 294660, 294664, 298090-93, 298099-100); Ch'onsong-ni, 6 (USNM 298094, 5 uncatalogued embryos); Ch'orwon, 1 (USNM 301916); vicinity Ch'orwon, 1 (KU 67232); Kumhwa, 6 (NSMJ—1 specimen; USNM 294665-66, 298096-98); Taegwang-ni, 300 ft., 2 (KU 60440; USNM 301255); ½ mi. S Taegwang-ni, 2 (USNM 301913-14); Ugu-dong, 3 (USNM 298957, 298960, 301254); White Horse Mt., NW of Ch'orwon, 1 (MCZ 47136); Yonch'on, 1 (USNM 301257); Yongp'yong, 110 m., 1 (KU 60441); central Korea, 2 (USNM 301917-18).

Additional records (Jones, MS): Oji-ri; Unson-ni, 100 m.; Yami-ri.

Microtus mandarinus kishidai Mori

Mandarin Vole

Microtus kishidai Mori, Jour. Chosen Nat. Hist. Soc., 10:53, July 31, 1930. Type locality: Seiryo-ri [= Ch'ongyang-ri], near Seoul, Korea.

Microtus mandarinus kishidai, Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian mammals, p. 710, November 19, 1951.

Distribution in Korea.—Known only from lowland areas in west-central and southwestern parts.

Measurements.—External measurements of an adult male, a young adult male, and an adult female from Suwon, 5 mi. W Kwangju, and the Hant'anch'on Valley, respectively, are: Total length, 137, 131, 131; length of tail-vertebrae, 23, 22, 20; length of hind foot, 18, 17, 18; length of ear from notch, 8, 10, 9. Cranial measurements of the two males are, respectively: Occipitonasal length, 24.8, 25.0; condylobasal length, 26.9, 26.6; palatal length, 16.0, 15.6; zygomatic breadth, 17.7, 16.3; breadth across auditory bullae, 12.5, 12.3; interorbital breadth, 4.3, 4.2; length of nasals, 7.0, 7.1; length of incisive foramina, 4.1, 3.5; length of maxillary tooth-row, 6.7, 6.6.

Remarks.—Microtus mandarinus kishidai is the darkest known subspecies of the species. The race of *M. mandarinus* nearest to *kishidai* geographically is *M. m. faeceus*, known from a place in Jehol nearly 500 miles to the north of the northernmost record of *kishidai*. Presumably the Mandarin vole will be found to occur in at least the western parts of North Korea.

This vole occupies lowland habitats along the Korean west coast at least as far north as the 38th parallel. Evidently it is rare, because the records enumerated herein bring the total number of known specimens only to 13. The individual from five miles west of Kwangju was trapped adjacent to a marshy area in a place overgrown with rank grasses.

Records of occurrence.—Specimens examined, 5, as follows: Hant'anch'on Valley (approximately 7 mi. ESE Yonch'on), 1 (USNM 297423); 5 mi. W Kwangju, 13 m., 1 (USNM 299098); 30 mi. NE Seoul, 1 (USNM 283678); Suwon, 1 (MCZ 43397); central Korea, 1 (37th Preventive Medicine Company, U. S. Army).

Additional records: Ch'ongyang-ri, near Seoul (type locality); Iksan-gun (Tokuda, 1941:140).

Family MURIDAE—Murids

Micromys minutus

Old World Harvest Mouse

This harvest mouse is common in central Korea, abundant in some places. Grassy areas in lowlands and on the lower slopes of hillsides seemingly constitute the preferred habitat. In summer and autumn, harvest mice make their homes in round nests of grass and leaves that are constructed in tall grasses, shrubs, or occasionally in small trees. In winter and spring, however, these mice apparently live in burrows, perhaps those abandoned by other small mammals. Individuals are most easily trapped in spring when food is scarce and vegetation has not yet reached heights suitable for nesting.

Breeding evidently takes place in all the warm months but, judging from our data, is concentrated in September and October. Litters of from 5 to 9 young have been recorded.

Micromys minutus hertigi Johnson and Jones

Micromys minutus hertigi Johnson and Jones, Proc. Biol. Soc. Washington, 68:167, December 31, 1955. Type locality: 2 mi. SE Mosulp'o, 3 m., Cheju Do (Quelpart Island), Korea.

Distribution in Korea.—Known only from Cheju Do.

Measurements.—External and cranial measurements of a young adult male and adult female (the holotype) are, respectively: Total length, 147, 160; length of tail-vertebrae, 81, 84; length of hind foot, 17, 18; length of ear from notch, 10, 10; occipitonasal length, —, 21.5; zygomatic breadth, —, 10.0; interorbital breadth, —, 3.8; length of nasals, —, 7.1; breadth of braincase, 9.7, 9.8; depth of braincase, 6.1, 6.3; length of maxillary tooth-row, —, 3.3.

Remarks.—From *Micromys minutus ussuricus* of the adjacent Korean mainland (specimens from various localities in central and southern Korea), *M. m. hertigi* differs as follows: Upper parts, in summer pelage, brighter ochraceous, especially middorsally; skull, in general, larger and more massive; zygomatic notches deeper; zygomatic processes of maxillae and squamosals broader and more massive in lateral view; nasals narrower and more attenuate posteriorly; mesopterygoid fossa relatively narrower, pterygoids less divergent posteriorly. From *Micromys minutus pygmaeus* of central and southern China (specimens from Yochow, Hunan), *M. m. hertigi* differs in: Upper parts (summer pelage) brighter ochraceous; occipitonasal length, nasal length, and zygomatic breadth greater; braincase much broader but not so deep; zygomatic notches deeper; nasals narrower; pterygoids less divergent posteriorly.

M. m. hertigi seemingly differs from all other described Oriental

subspecies of *Micromys minutus* in generally larger cranial size, deeper zygomatic notches, broader braincase, and brighter orchraceous upper parts. Specimens examined from the Korean mainland are uniformly darker dorsally than *hertigi* save for a specimen from Songu-ri, which approaches it in color. An adult male from five miles west of Kwangju, southwestern Korea, approaches *hertigi* in some cranial measurements.

Records of occurrence.—Specimens examined, 2, from the type locality (USNM 299103-04, including the holotype).

Micromys minutus ussuricus (Barrett-Hamilton)

Mus minutus ussuricus Barrett-Hamilton, Ann. Mag. Nat. Hist., ser. 7, 3:344, April, 1899. Type locality: Ussuri, Coast Province, southeastern Siberia.

Micromys minutus ussuricus, Thomas, Proc. Zool. Soc. London, 1906:863, April 11, 1907.

Distribution in Korea.—Entire peninsula in suitable habitats.

Measurements.—Average and extreme external and cranial measurements of seven adults (three males, four females) from west-central Korea are: Total length, 149.1 (140-163); length of tail-vertebrae, 76.1 (72-85); length of hind foot, 16.7 (15.5-18.0); length of ear from notch, 10.8 (10-13); occipitonasal length, 19.6 (19.2-20.4); zygomatic breadth, 9.5 (9.3-9.6); interorbital breadth, 3.4 (3.2-3.6); length of nasals, 6.2 (6.0-6.7); breadth of braincase, 9.2 (9.0-9.4); depth of braincase, 6.0 (5.6-6.3); length of maxillary tooth-row, 3.1 (3.0-3.4).

Weights in grams of four adults, one male and three non-pregnant females, from the vicinity of Seoul are, respectively: 10.4, 9.9, 11.6, 10.0.

Remarks.—For comparisons with *Micromys minutus hertigi* of Cheju Do see account of that subspecies. Two specimens examined from five miles west of Kwangju differ slightly in certain cranial features when compared with specimens from farther to the north; one approaches *hertigi* in several cranial measurements.

Many of our spring-taken specimens were born the previous autumn and are seemingly in a winter-like postjuvenal (as opposed to juvenal or adult) pelage. The dorsal areas of this pelage are dark brownish except for a paler, more reddish, rump patch. The underparts are darker than those in adult mice, having a grayish wash, and the lateral line is absent or indistinct.

Records of occurrence.—Specimens examined, 81, as follows: Chip'o-ri, 4 (USNM 294713, 298101, 298105, 301262); 2 mi. N Chip'o-ri, 150 m., 2 (KU 60428; USNM 298970); Ch'ongyang-ni, 1 (USNM 301376); Hant'anch'on Valley (approximately 7 mi. ESE Yonch'on), 5 (UMMZ 102508-12); 5 mi. W Kwangju, 13 m., 2 (USNM 299100-01); Manp'o, 11 (YI); Mun'gyong, 110 mi. SE Seoul, 1000 ft., 1 (BM 6.12.6.86); Munsan-ni, 2 (USNM 300453, 301261); Nongsa-dong, 6 (AMNH 34076-78, 34080-81; BM 13.5.27.57); 1 mi. N Oho-ri, 1-2 m., 2 (USNM 298968, 298971); Ori-dong, 1 (USNM 298103); 5 mi. ENE Pusan, 2 m., 1 (USNM 299102); 5 mi. E Seoul, 45 m., 2 (USNM 299525, 301931); 6 mi. E Seoul, 45 m., 16 (KU 64407-12, USNM 299099, 299517-22, 299524, 299577, 300649); Songu-ri, 1 (USNM 298104); Suwon, 5 (MCZ 43401-05); 10 mi. N Taegu, 1200 ft., 2 (BM 6.12.6.87-88); Taegwang-ni, 300 ft., 1 (KU 60431); 1 mi. W Tangjonggok, 425 m., 1 (USNM

298969); Tokkum-ni, 110 m., 1 (KU 60432); Tumen River, Korean-Manchurian border, 2500 ft., 4 (BM 1938.8.8.12-15); Unson-ni, 100 m., 2 (USNM 299516, 299523); 3 mi. SW Yanggu, 450 m., 3 (USNM 298965-67); Yonch'on, 1 (USNM 294714); Yongp'yong, 110 m., 2 (USNM 298964, 301260); central Korea, 2 (USNM 301258-59).

Additional records (Jones, MS, unless otherwise noted): Ch'onsong-ni (Lawrence and Harriss, MS); 4 mi. W Ch'ungju; Kyangyang-ni; 3 mi. S Osan, 17 m.; Seoul (Won, 1961:47); Taeam-dong (Kuroda, 1934:234); Taehoesan-ni; Tongp'yonch'on; Ugu-dong.

Apodemus agrarius

Striped Field Mouse

Four subspecies of *Apodemus agrarius* are herein recognized as occurring in Korea: *A. a. mantchuricus* in the extreme northern part; *A. a. coreae* throughout the major portion of the peninsula; *A. a. pallescens* in the coastal lowlands of southern and southwestern Korea; and *A. a. chejuensis* on Cheju Do (Quelpart Island).

A. a. chejuensis is a well-marked insular race, larger than any known subspecies of *Apodemus agrarius* and conspicuously darker than adjacent Korean (*A. a. pallescens*) or Chinese (*A. a. pallidior*) mainland specimens. Subspeciation on the Korean mainland is less clearly defined. Thomas (1899:774, footnote) named *A. a. mantchuricus,* a dark, long-furred subspecies having a distinct dorsal stripe, from Manchuria near the Korean-Manchurian border. Later (1908:8), after commenting on the considerable individual variation of the mice before him, Thomas described *A. a. coreae* from Min-gyong [= Mun'gyong] in south-central Korea, distinguishing it from *mantchuricus* as follows: "General colour above approximating to 'cinnamon' of Ridgway, not so ruddy as in *mantchuricus*. . . . Belly hairs grey basally, white terminally, not washed with tawny or buffy. Dorsal streak variable, but never of the clear well-defined unspeckled black throughout. . . ." We named *A. a. pallescens* (Johnson and Jones, 1955*a*:169), a drab-colored subspecies having an indistinct dorsal stripe, from eight miles southwest of Kunsan, Korea, as the terminus of a cline in color that extends from the forested, mountainous areas of Manchuria (dark), southward to the coastal lowlands of southern and southwestern Korea (pale). We also noted, to a lesser extent, a correlated increase in size from north to south.

The increase in size seemingly occurs primarily in the northern part of the cline. Specimens of *mantchuricus* available to us from several localities in southern Manchuria and from extreme northern Korea are smaller, both externally and cranially, than specimens of *coreae* from central Korea. Conversely, there is only a slight difference in size between *coreae* and *pallescens.* As concerns the

cline in color, if summer-taken specimens of *mantchuricus* from the Sungari River, Manchuria, are assigned a dorsal color rating of 10 and summer-taken specimens of *pallescens* from the type locality are assigned a dorsal color rating of 1, then summer-taken specimens from the Kumhwa-Ch'orwon area, here considered as representative of *coreae*, have an average dorsal color rating of between 6 and 7. *A. a. coreae*, then, differs from *mantchuricus* more in size than in color whereas the reverse is true when it is compared with *pallescens*. We emphasize that the differences discussed are average; most of the available series of *coreae* vary considerably.

We have seen no specimens from the vast area of northern Korea lying between the Yalu River on the north and the Kumhwa-Ch'orwon area on the south, a distance of more than 250 miles. When specimens are available from this area we would expect to find *mantchuricus* in the high mountains of extreme northern Korea and *coreae* in the north-central parts, and we would expect future specimens to illustrate a rather gradual change from north to south within the cline discussed above.

Curiously, a parallel cline, at least in color, extends westward from Manchuria and thence south along the North China coast to culminate in the pale race, *pallidior*, described from the Shantung Peninsula by Thomas (1908:8). Kuroda (1939:38) named an intermediate subspecies in this cline, *A. a. gloveri*, which was considered a synonym of *mantchuricus* by G. M. Allen (1940:957).

In central Korea striped field mice inhabit most available ecological niches but are especially abundant in open grassland, both in valleys and on hillsides. The species is common around the environs of man, especially along paddy dikes and in cultivated fields, and resides in forested areas wherever low cover and some open ground are present.

The breeding season extends from late March or early April to mid-October with a slack period in mid-summer. Many females give birth to several litters each year. The number of young per litter ranges from 2 to 9, averaging between 5 and 6.

Apodemus agrarius chejuensis Johnson and Jones

Apodemus agrarius chejuensis Johnson and Jones, Proc. Biol. Soc. Washington, 68:171, December 31, 1955. Type locality: 10 mi. NE Mosulp'o, 420 m., Cheju Do (Quelpart Island), Korea.

Distribution in Korea.—Known only from Cheju Do.

Meaurements.—Average and extreme external measurements of nine adults (eight males, one female), including the holotype, are: Total length, 222.8 (216-232); length of tail-vertebrae, 103.1 (96-107); length of hind foot, 23.8 (23-25); length of ear from notch, 15.7 (15-17). For cranial measurements see Table 4.

Remarks.—From *Apodemus agrarius pallescens* of the adjacent coastal areas of the Korean mainland, *A. a. chejuensis* differs in being larger, both externally and cranially, and in having darker upper parts, feet, tail, and ears, a more distinct dorsal stripe, and underparts that are tinged with buff. *A. a. chejuensis* differs in most of the same features from *A. a. pallidior* of northeastern China, *A. a. coreae* of central Korea, and *A. a. mantchuricus* of northern Korea and Manchuria. The dorsal coloration of *chejuensis* approaches that of *mantchuricus* but is richer and has a more cinereous appearance.

A. a. chejuensis is larger, both externally and cranially, than any other described subspecies of *Apodemus agrarius* and is easily distinguished from the other known races. The rich, dark coloration of *chejuensis* seems to reflect the color of the dark, reddish volcanic soils found on Cheju Do.

Records of occurrence.—Specimens examined, 34, all from Cheju Do as follows: Halla-san, 4000 ft., 2 (YI 98-99); 2 mi. SE Mosulp'o, 3 m., 3 (USNM 299220-22); 4 mi. E Mosulp'o, 100 m., 5 (USNM 299215-19); 6 mi. NE Mosulp'o, 200 m., 9 (USNM 299207-14, 299627); 10 mi. NE Mosulp'o, 420 m., 5 (USNM 299203-06, 299626, including the holotype); Sogwi-ri, 2500 ft., 1 (YI 100); 6 mi. NNE Sogwi-ri, 460 m., 2 (USNM 299223-24); no exact locality, 3000-4500 ft., 7 (BM 6.12.6.5-11).

Additional record: near Sogwi-ri, 1200 m. (Won and Woo, 1958*a*:9).

Apodemus agrarius coreae Thomas

Apodemus agrarius coreae Thomas, Proc. Zool. Soc. London, 1908:8, July 3, 1908. Type locality: Min-gyong [= Mun'gyong], 110 mi. SE Seoul, 1000 ft., Korea.

Distribution in Korea.—Entire peninsula excepting extreme northern part and coastal lowlands in south and southwest.

Measurements.—Average and extreme external measurements of ten adults (eight males, two females) from the vicinity of Ch'orwon are: Total length, 201.2 (188-212); length of tail-vertebrae, 91.2 (80-102); length of hind foot, 21.7 (19-23); length of ear from notch, 14.4 (13-15.5). For cranial measurements see Table 4.

Three adults, two males and a non-pregnant female, from 5-6 mi. E Seoul weighed 35.0, 33.5, and 38.8 grams, respectively. Two adult males from Taegwang-ni weighed 35.1 and 37.3.

Remarks.—From *Apodemus agrarius mantchuricus,* geographically adjacent to the north, *A. a. coreae* differs as follows: Larger, both externally and cranially; skull more robust; underparts averaging paler in comparable pelages; dorsal stripe averaging narrower and less distinct. From *Apodemus agrarius pallescens,* geographically adjacent to the southward, *A. a. coreae* differs in averaging slightly smaller in both external and cranial dimensions, and in having darker upper parts and a darker, more distinct dorsal stripe. For comparisons with *Apodemus agrarius chejuensis* of Cheju Do, see account of that subspecies.

TABLE 4.—CRANIAL MEASUREMENTS OF FOUR SUBSPECIES OF APODEMUS AGRARIUS

Number of specimens averaged or catalogue number, and sex	Occipitonasal length	Zygomatic breadth	Mastoid breadth	Interorbital breadth	Breadth of braincase	Depth of skull	Length of nasals	Length of incisive foramina	Length of maxillary tooth-row
Apodemus agrarius mantchuricus, Sungari River, Manchuria									
Average 8 (4♂, 4♀)	26.1	12.6	10.7	4.4	11.3	9.6	9.9	5.2	4.3
Minimum	25.1	12.3	10.2	4.1	10.7	9.2	9.3	5.0	4.1
Maximum	26.6	12.9	10.9	4.6	11.6	9.9	10.4	5.6	4.4
Apodemus agrarius coreae, vicinity Ch'orwon, Korea									
Average 8 (4♂, 4♀)	27.4	13.1	11.5	4.5	11.7	10.0	10.7	5.3	4.3
Minimum	26.3	12.7	11.3	4.2	11.5	9.7	10.4	4.9	4.0
Maximum	27.8	13.5	11.8	4.7	12.0	10.2	10.9	5.7	4.5
Apodemus agrarius pallescens, 8 mi. SW Kunsan, Korea									
USNM 299161, ♀ (type)	28.8	13.7	11.9	4.5	12.3	10.0	10.8	5.6	4.1
Average 8 (5♂, 3♀)	27.9	13.0	11.4	4.5	11.7	10.0	10.5	5.6	4.3
Minimum	27.1	12.5	11.0	4.3	11.3	9.7	10.1	5.3	4.1
Maximum	29.0	13.5	12.0	4.8	12.1	10.3	10.9	6.0	4.4
Apodemus agrarius chejuensis, vicinity Mosulp'o, Cheju Do, Korea									
USNM 299204, ♂ (type)	30.2	13.6	12.0	4.8	13.0	10.8	11.7	5.7	4.4
Average 8 (7♂, 1♀)	30.1	13.7	11.8	4.8	12.4	10.3	11.5	5.8	4.4
Minimum	29.5	13.0	11.6	4.6	11.6	9.9	11.0	5.7	4.2
Maximum	30.6	14.4	12.0	5.1	12.7	10.8	11.7	6.0	4.5

A. a. coreae seemingly inhabits most of the Korean mainland, giving way to *mantchuricus* in the extreme northern parts of the peninsula and to *pallescens* in the coastal areas of the south and southwest. In the southern part of the peninsula, where *coreae* inhabits the higher elevations and *pallescens* the lowland coastal areas, there is a broad zone of intergradation all along where the central highlands merge with the coastal lowlands. As might be expected, specimens from these areas are difficult to assign with certainty to either of the two subspecies. Mice available to us from the vicinities of Seoul, Suwon, Ch'ongju, and Tongbok, here assigned to *coreae*, approach *pallescens* in dorsal coloration and ap-

pearance of the dorsal stripe. Conversely, specimens from the vicinities of Osan and Pusan, here regarded as *pallescens,* are slightly darker than specimens from the type locality of the latter and thus approach *coreae.*

Records of occurrence.—Specimens examined, 471, as follows: Central National Forest, near Pup'yong-ni, 100-200 m., 55 (KU 63852-95; UMMZ 99590; USNM 298153-57, 299110-11, 299527, 299529, 299551-52); Changjon, 200 ft., 1 (YI); Chang-ni, 1 (USNM 298130); Chip'o-ri, 22 (KU 63842; NSMJ—1 specimen; USNM 294667-68, 294670-75, 298109-15, 299582, 301511-14); 2 mi. N Chip'o-ri, 150 m., 1 (KU 60419); 3 mi. NW Chip'o-ri, 145 m., 3 (KU 60420-21; USNM 299105); Ch'ongju, 500-800 ft., 15 (BM 7.6.3.35-49); Ch'ongyang-ni, 7 (UMMZ 99589; USNM 294684-86, 298123-25); Ch'onsong-ni, 12 (USNM 294687-91, 298116-22); 4 mi. W Ch'ungju, 100 m., 2 (KU 60427, USNM 298984); 7 mi. W Ch'ungju, 100 m., 5 (USNM 299546-50); Hant'anch'on Valley, approximately 7 mi. ESE Yonch'on, 3 (UMMZ 102514-16); Kaloguai, 55 mi. NE Seoul, 500 ft., 1 (BM 7.6.3.33); 3 mi. SE Kangnung, 6 m., 3 (USNM 298987-89); 8 mi. SW Kangnung, 550 m., 2 (USNM 298985-86); Kuksa-bong, 2 (USNM 298158-59); Kumhwa, 11 (USNM 294694-98, 298126-29; YI—2 specimens); Kumhwa Valley, 2 (USNM 294609-10); Mun'gyong, 8 (BM 6.12.6.71-78, including the holotype); Munsan-ni, 50 ft., 17 (CM—13 specimens; KU 67235; USNM 300449-51); 5 mi. S Munsan-ni, 1 (KU 67236); Nap'a-dong, 6 mi. NE Munsan-ni, 2 (KU 60425-26); 1 mi. N Oho-ri, 1-2 m., 4 (USNM 298979-80, 298991-92); 1 mi. NW Oho-ri, 6 m., 1 (USNM 298990); Ori-dong, 8 (USNM 298131-38); Penchan, 50 mi. NE Seoul, 300 ft., 5 (BM); Seoul, 144 (NSMJ—7 specimens; USNM 283638-40, 297276-396, 298149-52, 299603-11); 5 mi. E Seoul, 2 (USNM 298975-76); 6 mi. E Seoul, 45 m., 20 (KU 63843-45; USNM 299534-45, 299555-58, 299584); 10 mi. NE Seoul, 1 (USNM 283675); 65 mi. NE Seoul, 300 ft., 1 (BM 7.6.3.34); Sinsul-li, 2 (USNM 298139-40); 2 mi. E Songdong-ni, 95 m., 2 (USNM 299108-09); Songu-ri, 6 (USNM 294881-83, 298160-62); 3 mi. SSE Sumil-li, 1468 m., 2 (USNM 299106-07); Suwon, 20 (MCZ 43408-25, NSMJ—2 specimens); 2 mi. S Suwon, 27 m., 15 (USNM 299114-27, 299629); 10 mi. N Taegu, 1200 ft., 7 (BM 6.12.6.79-85); Taegwang-ni, 90 m., 9 (KU 60410-18); 1 mi. W Tangjonggok, 425 m., 3 (USNM 298981-83); Tokkum-ni, 110 m., 2 (USNM 298995-96); Toktun-ni, 2 (USNM 294693, 298163); ½ mi. N. T'ongjin, 40 m., 2 (USNM 298993-94); Tongbok, 11 (BM 6.12.6.60-70); Ulsan, 3 (AMNH 34106-08); Unson-ni, 100 m., 2 (USNM 299532-33); White Horse Mt., NW Ch'orwon, 1 (MCZ 47135); 3 mi. SW Yanggu, 450 m., 2 (USNM 298977-78); Yonch'on, 12 (USNM 294676-78, 294680, 298141-48); 4 mi. S Yonch'on, 2 (USNM 294679, 294699); 5 mi. SSE Yonch'on, 1 (USNM 294692); no exact locality, 3 (CM—1 specimen; USNM 283676-77).

Additional records (Jones, MS, unless otherwise noted): Anju (Kuroda, 1938:59); Ch'angch'on (Won, 1961:46); Chiri-san (Won, 1961:46); Ch'ongyang-ri (Won and Woo, 1961:122); 17 mi. SE Ch'orwon (Jameson and Toshioka, 1954:14); 10 mi. W Ch'unch'on (Jameson and Toshioka, 1954:12); Hongch'on (Won and Woo, 1961:122); 4 mi. E Inch'on (Jameson and Toshioka, 1954:14); Kwangnung (Won, 1961:46); Kyangyang-ni; Sangbonch'on-ni; Sorak-san (Won, 1961:46); Taehoesan-ni; Tongp'yongch'on; Ugu-dong; Wasu-ri; 2 mi. SE Yonch'on (Jameson and Toshioka, 1954:18); Yongp'yong.

Apodemus agrarius mantchuricus (Thomas)

Mus agrarius mantchuricus Thomas, Proc. Zool. Soc. London, 1898:774, footnote, April, 1899. Type locality: Manchuria, near the Korean-Manchurian border.

A[podemus]. a[grarius]. mantchuricus, Thomas, Proc. Zool. Soc. London, 1908:8, July 3, 1908.

Distribution in Korea.—Extreme northern part.

Measurements.—External measurements of an adult female from 150 mi. up the Yalu River, Korea, followed by the average and extreme external measurements of seven adults (three males, four females) from Sungari River, Manchuria, are: Length of head and body, 105, 104.8 (96-111); length of tail, 89, 79.3 (69-91); length of hind foot, 20, 20.4 (19-22); length of ear from notch, 15, 13.6 (13-14). For additional external measurements see Allen and Andrews (1913:431). For cranial measurements see Table 4.

Remarks.—For comparison with *Apodemus agrarius coreae*, geographically adjacent to the south, see account of that subspecies.

A. a. mantchuricus is confined in Korea to the mountainous areas of the extreme northern parts of the peninsula. Allen and Andrews (*loc. cit.*) reported that "specimens were most frequently trapped about stone piles in the valleys and seemed to like fairly open ground. None were taken in heavy forests."

Records of occurrence.—Specimens examined, 31, as follows: Chunggangjin, 1 (AMNH 34105); Daichi-bei, 1 (AMNH 34082); Manp'o, 50 ft., 6 (YI); Musan, 6 (AMNH 34087, 34089, 34091-92; BM 13.5.27.47-48); Pochong, 1 (AMNH 34014); Potai-dong, 4 (AMNH 34084; BM 13.5.27.49-50, 13.5.27.52); P'ungsan-dong, 10 (AMNH 34094-97, 34099-101; BM 13.5.27.51; MCZ 15290-91); 150 mi. up Yalu River, 1 (USNM 199655); northeastern Korea, 1 (AMNH 34083).

Additional record: Chuuronjang (Kishida, 1936:138).

Apodemus agrarius pallescens Johnson and Jones

Apodemus agrarius pallescens Johnson and Jones, Proc. Biol. Soc. Washington, 68:169, December 31, 1955. Type locality: 8 mi. SW Kunsan, 10 m., Korea.

Distribution in Korea.—Coastal lowlands in southern and southwestern parts.

Measurements.—Average and extreme external measurements of nine adults (five males, four females), including the holotype, from the type locality are: Total length, 205.1 (195-217); length of tail-vertebrae, 90.0 (79-94); length of hind foot, 22.0 (21-23); length of ear from notch, 14.4 (14-15). For cranial measurements see Table 4.

Remarks.—For comparison with *Apodemus agrarius coreae*, geographically adjacent to the north, and with *Apodemus agrarius chejuensis* of Cheju Do, see accounts of those subspecies.

A. a. pallescens, as we have pointed out above, represents the southern terminus of a cline in color, and to a lesser extent in size, which extends from Manchuria southward to the southern parts of Korea. This subspecies is the most drab-colored of the races of *Apodemus agrarius* in eastern Asia and can be distinguished from all others on the basis of that character.

Specimens here assigned to *pallescens* from three miles south of Osan and from the vicinity of Pusan average slightly darker than specimens from the type locality and approach *A. a. coreae* in this regard. The specimens labeled with reference to Osan are from the northern edge of the range of *pallescens* because mice from the

vicinity of Suwon, approximately 20 miles northward, as well as specimens from coastal areas in the vicinity of T'ongjin and Munsan-ni are referable to *coreae.* The specimens from Pusan are from the eastern edge of the L-shaped range of *pallescens;* striped field mice from the narrow coastal areas of eastern Korea are referable to *coreae.*

Records of occurrence.—Specimens examined, 87, as follows: 8 mi. SW Kunsan, 10 m., 28 (USNM 299143-70, including the holotype); 5 mi. W Kwangju, 13 m., 16 (USNM 299171-86); Mokp'o, 100-300 ft., 6 (BM 6.12.6.56-59; YI—2 specimens); 3 mi. S Osan, 17 m., 15 (USNM 299128-42); Pusan, 6 (BM 6.12.6.55; USNM 191863, 298164-67); 5 mi. ENE Pusan, 2 m., 16 (USNM 299187-201).

Apodemus peninsulae peninsulae (Thomas)

Wood Mouse

Micromys speciosus peninsulae Thomas, Proc. Zool. Soc. London, 1906:862, April 11, 1907. Type locality: Min-gyong [= Mun'gyong], 110 mi. SE Seoul, 1200 ft., Korea.

Apodemus peninsulae, Miller, Proc. Biol. Soc. Washington, 27:89; May 11, 1914.

Distribution in Korea.—Entire peninsula in suitable habitats.

Measurements.—Average and extreme external and cranial measurements of 10 adults (four males, six females) from west-central Korea are: Total length, 219.7 (200-228); length of tail-vertebrae, 108.8 (100-115); length of hind foot, 25.1 (24.0-26.5); length of ear from notch, 16.2 (15-18); occipitonasal length, 29.2 (28.3-29.8); zygomatic breadth, 14.2 (13.8-14.6); mastoid breadth, 11.8 (11.5-12.2); interorbital breadth, 4.7 (4.6-5.1); length of nasals, 11.4 (10.8-12.0); depth of skull, 10.2 (9.9-10.5); alveolar length of maxillary toothrow, 4.3 (4.1-4.4).

One male and two non-pregnant females from the vicinity of Seoul weighed 31.4, 41.9, and 32.7 grams, respectively.

Remarks.—We follow Jones (1956) and Zimmermann (1962) in recognizing *A. peninsulae* as specifically distinct from the European *A. flavicollis;* Zimmermann, in fact, regarded the two species as belonging to different subgenera (*Alsomys* and *Sylvaemus,* respectively). Ellerman (1949:34) and Ellerman and Morrison-Scott (1951:571) recorded *"Apodemus sylvaticus draco"* as occurring in Korea but listed no specific localities or actual specimens. If specimens actually formed the basis for this reference, we suppose they are in the British Museum. One of us (Johnson) examined all the Korean *Apodemus* in that institution in 1955 and, except for specimens representing the several subspecies of *Apodemus agrarius,* all seemed clearly referable to *peninsulae.* Possibly Ellerman's report of *draco* was based on young specimens of *A. peninsulae.*

Of 64 skins and alcoholic specimens of wood mice in the U. S. National Museum from central Korea, 45 (70 per cent) have areas of white mottling, which are composed of hairs completely lacking

in pigment. These white areas are usually confined to the venter and lower flanks but on some specimens reach high onto the sides and over the hind legs. This same phenomenon was noted also in wood mice from central Korea in other collections. White patches were clearly evident, for example, on six of 13 specimens examined in the British Museum and illustrated to a lesser extent on several others, including the holotype of *peninsulae*. Specimens available to us from southern Korea (Taegu and Pusan) and from the extreme northern parts of the peninsula do not exhibit this phenomenon, nor was it noted in any of more than one hundred Manchurian and Chinese specimens of the species. Many Korean specimens also have a white tip five to ten millimeters long on the tail.

The wood mouse is common in forested areas and on scrub-covered hillsides and talus slopes throughout much of Korea. In the Central National Forest individuals were trapped most commonly on heavily wooded hillsides in the vicinity of granite outcroppings. Allen and Andrews (1913:432) wrote of the species along the Manchurian border in extreme northeastern Korea as follows: "This mouse is fairly abundant in northern Korea, and was found most frequently at the edge of the larch forests and near clearings. At Nonsatong the greatest number were collected, and were taken about tree stumps, old logs and large rocks."

Little has been reported concerning reproduction in this species. In our material pregnant or lactating females are on hand from as early as April and from as late as October; the available counts of embryos and litters indicate 2 to 8 young per pregnancy.

Records of occurrence.—Specimens examined, 130, as follows: Central National Forest, near Pup'yong-ni, 200 m., 37 (KU 63846-49, 67238; UMMZ 99591; USNM 298169-73, 299112-13, 299230-40, 299530-31, 299553, 299559, 299585, 300650-51, 301263-64, 301269, 301373-75); Changjon, 2000 ft., 1 (YI); Chip'o-ri, 8 (USNM 294669-75, 301265); Ch'ongju, 800 ft., 4 (BM 7.6.3.25-28); Ch'ongyang-ni, 1 (USNM 294706); 8 mi. SW Kangnung, 550 m., 3 (USNM 298972-74); Kuksa-bong, 1 (USNM 298177); Kumhwa, 6 (BM 7.6.3.24; USNM 294709-12, 301268); 6 mi. SE Kumhwa, 1 (USNM 301921); Manp'o, 1 (YI); Mun'gyong, 110 mi. SE Seoul, 1300 ft., 9 (BM 6.12.6.38-46, including the holotype); Munsan-ni, 50 ft., 1 (CM); 7 mi. SSE Munsan-ni, 1 (USNM 302913); Musan, 2 (AMNH 34066-67); Nongsa-dong, 4 (AMNH 34058; MCZ 15288-89; BM 13.5.27.60); 13½ mi. SW Nongsa-dong, 1 (BM 13.5.27.59); 18 mi. SW Nongsa-dong, 4 (AMNH 34053, 34056, 34061; BM 13.5.27.58); 43 mi. SW Nongsa-dong, 1 (AMNH 34068); Pochong, 1 (AMNH 34059); Potai-dong, 3 (AMNH 34060; USNM 197974-75); P'ungsan-dong, 5 (AMNH 34052, 34062, 34065, 34093; BM 13.5.27.61); near Pusan, 5 (USNM 301368-72); Sangbonch'on-ni, 3 (KU 60422-23; USNM 301270); 6 mi. E Seoul, 45 m., 2 (USNM 299612, 299526); 3 mi. SSE Sumil-li, 1468 m., 4 (KU 60424, 67237; USNM 299229, 301266); 10 mi. N Taegu, 1200 ft., 8 (BM 6.12.6.47-54); Toktun-ni, 2 (USNM 294707-08); Tumen River, Korean-Manchurian border, 2500 ft., 1 (BM 1938.8.8.11); 150 mi. up Yalu River, 3 (USNM 199662-64); Yangmun-ni, 1 (NSMJ); Yangwon-ni, 1 (USNM 301267); 6 mi. S Yongdungp'o, 1 (USNM 299554); central Korea, 4 (USNM 301922-25).

Additional records: Anju (Kuroda, 1938:63); Chiri-san (Won, 1961:46); Chuuronjang (Tokuda, 1941:144); Kwangnung (Won, 1961:46); Seoul (Whang, 1959:69); Sorak-san (Won, 1961:46).

Rattus norvegicus caraco (Pallas)

Norway Rat

Mus caraco Pallas, Novae species quadrupedum e glirium ordine, p. 91, 1778. Type locality: China and far eastern Siberia.

Rattus norvegicus caraco, Vinogradov and Obolensky, Jour. Mamm., 8:237, August 9, 1927.

Distribution in Korea.—Entire peninsula and adjacent islands (including at least Cheju Do, Chi Do, and Ullung Do).

Measurements.—Average and extreme external and cranial measurements of 10 adults and young adults (five males, five females) from west-central Korea in the vicinity of Seoul are: Total length, 325.1 (302-355); length of tail-vertebrae, 154.2 (140-167); per cent length of tail to length of head and body, 91.0 (84-114); length of hind foot, 33.1 (30-38); length of ear from notch, 19.2 (18-20); condylobasal length, 39.0 (37.2-41.1); zygomatic breadth, 19.5 (18.7-20.5); lambdoidal breadth, 16.2 (15.6-17.0); interorbital constriction, 5.8 (5.6-6.4); length of rostrum, 14.1 (13.1-15.4); length of incisive foramina, 6.8 (6.4-7.1); length of maxillary tooth-row, 6.8 (6.5-7.1); length of auditory bulla, 7.0 (6.6-7.5).

Remarks.—Judging from the specimens in the U. S. National Museum, the Korean populations of *Rattus norvegicus* represent a moderate-sized and rather dark-colored subspecies that is widely distributed also in northeastern China, Manchuria, and on the Japanese island of Hokkaido, and possibly even beyond that broad area. It presumably occurs in the Maritime Provinces of Siberia, whence we have no specimens. We believe that the name *caraco* of Pallas is properly applied to this race. The general range of the subspecies as thus outlined includes territory that is, or once was, moderately well forested.

Contrasting with *R. n. caraco* are two smaller and paler Chinese races from more arid regions to the west, *socer* from Kansu and *insolatus* from Shensi (each known to us by the holotype), and certain large, coarse-haired rats from various localities in Japan and coastal areas to the southward that are, or at least bear strong resemblance to, *R. n. norvegicus.*

Insofar as we are aware, the type locality of *caraco* has not been restricted to a definite site. Some recent authors, for example Ellerman and Morrison-Scott (1951:589), have listed it as "Eastern Siberia." The geographical designation in the original description is "e China in orientaliorem Sibiriam dispersa." This we translate freely to mean "distributed from China into easternmost Siberia," which agrees with our concept of the range of the subspecies rather well.

The name *Rattus humiliatus sowerbyi* of A. H. Howell (1928:42) was based on two specimens (USNM 199620 and 199619, holotype and paratype respectively) collected by A. deC. Sowerby at "I-mien-po, northern Kirin Province, Manchuria," in mid-October, 1915. They are distinguished from a large series of *caraco* collected by Sowerby the previous summer at various localities in Manchuria only by characters that are typical of the fresh winter pelage in contrast to the worn summer pelage. The fur is longer, finer, and denser, and the color on the dorsal surface is darker because of the longer and less abraded black bristles. We therefore believe *sowerbyi* to be a name for the same kind of Norway rat that occurs in Korea and to be a synonym of *caraco*.

From the original description, *Rattus norvegicus orii* Kuroda (1952:2), from Uenai, Hokkaido, Japan, must be identical with the race that we identify as *caraco*, or at least close to it. We find no apparent differences between our Korean specimens and a large series of Norway rats from Sapporo, Hokkaido, now in the U. S. National Museum.

For a discussion of the status of "*Rattus norvegicus longicaudus*" Mori, described from Ullung Do, off the east coast of Korea, see the account of *Rattus rattus flavipectus*.

Records of occurrence.—Specimens examined, 54, as follows: Central National Forest, 2 (USNM 298190-91); Chip'o-ri, 3 (USNM 294715-16, 298183); 4 mi. SW Chon'gong-ni, 1 (USNM 301278); Ch'ongyang-ni, 1 (USNM 298186); 5 mi. W Kwangju, 1 (USNM 299228); Kumhwa, 2 (USNM 298184-85); Munsan-ni, 1 (USNM 300454); Nongsa-dong, 1 (AMNH 34048); Ori-dong, 2 (USNM 298187-88); 17 mi. W Osan, 3 (USNM 299614-16); 5 mi. ENE Pusan, 1 (USNM 299226); Seoul, 23 (USNM 297402-17, 299618-24); 5 mi. E Seoul, 2 (USNM 301275, 301377); 5 mi. NE Seoul, 1 (USNM 299617); 7 mi. NE Seoul, 5 (USNM 297397-401); Songu-ri, 1 (USNM 298192); Suwon, 2 (MCZ 43399-400); Yangwon-ni, 1 (USNM 301276); Yonch'on, 1 (USNM 298189).

Additional records: Anju (Kuroda, 1934:234); Changjon, 300-2000 ft., (Kuroda, 1934:234); Chi Do, near Mokp'o (Kuroda, 1934:234); Chiri-san (Won and Woo, 1959:128); 7 mi. SE Ch'orwon (Jameson and Toshioka, 1954:14); Chuuronjang (Tokuda, 1941:151); Hamhung (Imaizumi, 1939: 106); Manp'o (Kuroda, 1934:234); Sa-dong, Ullung Do (Won and Woo, 1956:16); Sogwi-ri, Cheju Do (Kuroda, 1934:234); Sorak-san (Won *et al.*, 1959:18); To-dong, Ullung Do (Won and Woo, 1956:16).

Rattus rattus flavipectus (Milne-Edwards)

House Rat

Mus flavipectus Milne-Edwards, Nouv. Arch. Mus. Hist. Nat. Paris, Bull., 7:93, 1871. Type locality: Muping, Szechwan.

Rattus rattus flavipectus, Ellerman, The families and genera of living rodents, 3:58, March, 1949.

Rattus norvegicus longicaudus Mori, Jour. Chosen Nat. Hist. Soc., 22:40 (Japanese) and 42 (English), September 1, 1937. Type from Utsuryo Island [= Ullung Do], Korea.

Distribution in Korea.—Central and southern parts of peninsula, principally in towns and villages; also on Cheju Do and Ullung Do.

Measurements.—Average and extreme external measurements, taken from specimens preserved in alcohol, of eight adults (two males, six females) from Pusan are: Total length, 321.3 (289-340); length of tail-vertebrae, 171.2 (150-185); per cent length of tail to length of head and body, 114.1 (106-123); length of hind foot, 32.7 (30-35); length of ear from notch, 15.9 (14-18). For cranial measurements see Table 5. For additional external and cranial measurements of Korean specimens see Won and Woo (1956:14-16 and 1960:50), and Whang (1959).

Remarks.—Our efforts to determine the correct name for the house rat of Korea have led to a review of the rats of this type in China and Japan as well. In China, it is readily apparent that a comparatively short-tailed rat with a buffy suffusion on the belly occupies a broad geographic area from Szechwan eastward across the southern provinces to Fukien and the vicinity of Shanghai. Several series of this rat, which seems to be the *flavipectus* of Milne-Edwards, are available in the U. S. National Museum (G. M. Allen, 1940:994-998, also applied the name *flavipectus* to individuals from southern China after studying other material). Further, specimens at hand from Korea and the Japanese islands of Hokkaido and Honshu have these same characteristics, and we consider them also to be referable to *flavipectus.* Most modern workers find it convenient to treat *flavipectus* and certain other kinds of Asiatic house

TABLE 5.—CRANIAL MEASUREMENTS OF RATTUS RATTUS FLAVIPECTUS

Catalogue number and sex	Condylobasal length	Zygomatic breadth	Interorbital constriction	Length of rostrum	Length of incisive foramina	Length of maxillary tooth-row	Length of auditory bulla
			Foochow, Fukien, China				
USNM 282757, ♂	37.9	18.6	5.4	14.0	7.1	6.8	6.8
USNM 282759, ♂	39.0	19.3	5.8	14.9	7.9	7.1	6.9
USNM 282760, ?	40.7	19.9	5.8	16.2	8.5	7.0	6.9
			Sapporo, Hokkaido, Japan				
UNSM 281690, ♂	37.9	19.4	6.5	14.3	7.2	7.0	7.2
USNM 281691, ♂	37.8	19.4	5.8	14.2	7.2	6.8	6.6
USNM 281693, ♀	37.8	18.1	5.8	14.3	7.2	7.1	7.4
USNM 281695, ♀	41.4	21.3	6.4	15.9	8.1	7.4	7.5
USNM 281701, ♀	38.5	19.3	5.9	14.5	7.5	7.1	6.9
			Taigu, Korea				
USNM 297433, ♀	36.8	18.0	5.7	14.1	7.7	6.5	6.3
USNM 297434, ♂	38.3	18.1	5.7	14.4	7.1	6.7	6.6
USNM 297436, ♂	38.3	18.2	6.0	14.4	7.7	6.7	7.0

rats as subspecies of *Rattus rattus* and, for the present, we follow this practice, fully realizing that the total picture of relationships among the various kinds of *Rattus* in the Orient is far from clear.

Several other names have been used in the subspecific sense for house rats from northeastern Asia, particularly Japan. Two that occur frequently in the literature are *rattus* and *alexandrinus*. Each of these names was based originally on a different color phase of the house rat or roof rat of western Europe and the Mediterranean region (*Rattus rattus rattus*), a subspecies that seldom is found in eastern Asia except in the holds of ships. It seems never to have become established permanently on the mainland or adjacent islands, probably owing to the presence there of well entrenched populations of *R. r. flavipectus* or other races that resemble *R. r. rattus* in size and have about the same ecological requirements.

In a restricted sense the subspecific name *rattus* has been used most frequently to designate the melanistic color phase of the European house rat, and unfortunately it frequently has been applied by mistake to black individuals of other subspecies and even of another species, *Rattus norvegicus*. We are therefore inclined to view Asian records of "*Rattus rattus rattus*" with considerable skepticism, especially where it appears that identifications were based solely or principally on black color.

Many authors have applied the name *alexandrinus* to the Japanese and Korean populations that we here call *flavipectus*. The latter may be distinguished from true "*alexandrinus*" (the brown-backed, dusky-footed, and dusky-bellied color phase of the European house rat) by the shorter tail, paler feet on which dark color is restricted to definable patches on the upper surfaces, and the conspicuous surface wash of buff color on the underparts.

Two names now of uncertain status are *erythronotus* and *tanezumi*, both proposed by Temminck (1845:50-51) for specimens from Japan. Both of these names probably were based on specimens from the vicinity of Nagasaki on the southern island of Kyushu, where the house rat is of a paler-bellied subspecies than *flavipectus*. Temminck's names thus are not applicable to the house rat in Korea and for present purposes need not be considered further.

The rat that Mori (1937:40, 42) described under the name *Rattus norvegicus longicaudus* from Ullung Do, an island in the Sea of Japan approximately 85 miles off the eastern coast of Korea, apparently is some form of *Rattus rattus*. The measurements presented by Mori indicate large ears and a tail that is consistently

longer than the head and body. The color of the underparts was described as "greyish white, usually washed with creamy buff." The original series of *longicaudus* is no longer in existence, having been destroyed along with the rest of Mori's collection as a result of combat operations in Seoul in 1950 and 1951. Won and Woo (1960), after examining a series of specimens from Ullung Do that they believed to represent the rat named by Mori, concluded that the latter was indistinguishable from "*Rattus rattus alexandrinus*." We have seen no specimens from Ullung Do.

Finally, there is the rat from Nopporo, Hokkaido, named *Rattus rattus brevicaudus* by Kuroda (1952:1). Except that Kuroda's measurements show an unusually short tail for the type specimen (only 144 mm. or 80 per cent of the head-and-body length of 168 mm.), the description seems to apply well to a series of specimens from Sapporo, Hokkaido, in the U. S. National Museum. In eight of these specimens the tail varies from 90 to 121 per cent of the head-and-body length, with an average of 105 per cent. The average of this ratio in our Korean specimens is 114 per cent, but the significance of the difference is lessened by the fact that the measurements were taken by different collectors and possibly by different methods. In all other respects, the specimens examined from Korea and Hokkaido closely resemble the described characters of *brevicaudus*, and we believe that they represent the same subspecies. Therefore we provisionally regard *brevicaudus* as a synonym of *flavipectus*.

Records of occurrence.—Specimens examined, 26, as follows: Central National Forest, near Pup'yong-ni, 200 m., 1 (USNM 299225); 1 mi. N Mosulp'o, 10 m., Cheju Do, 1 (USNM 299628); Pusan, 11 (USNM 60392-94, 191703-04, 297427-32); 5 mi. E Seoul, 3 (USNM 301271, 301273-74); 7 mi. NE Seoul, 3 (USNM 297418-20); 3 mi. SSE Sumil-li, 1 (USNM 301272); Taegu, 6 (USNM 297433-38).

Additional records: near Cheju, Cheju Do (Won and Woo, 1958*a*:7); Chiri-san (Won and Woo, 1959:128); 17 mi. SE Ch'orwon (Jameson and Toshioka, 1954:14); Hadong (Won and Woo, 1960:50); Mokp'o (Kuroda, 1934:234); Seoul (Whang, 1959:69); Sogwi-ri, 50 ft., Cheju Do (Kuroda, 1934:234); near Sogwi-ri, 1200 m., Cheju Do (Won and Woo, 1958*a*:9); Sorak-san (Won *et al.*, 1959:18); To-dong, Ullung Do (Won and Woo, 1956:14).

Mus musculus

House Mouse

In studying the house mice of Korea and adjacent areas, we have arranged the available specimens and approached the problem as we would for any other indigenous group of mammals. We are aware that the species is closely associated with human culture and that modifications in the distribution and to some extent the

characters have resulted from this association. These factors must be kept in mind in doing taxonomic work with house mice or with any other commensal species, but we do not believe that they justify departure from orthodox taxonomic procedures. The Korean specimens before us, obtained from both rural and urban environments, show marked uniformity in color, measurements, and cranial features. When all the material available from northeastern Asia is studied, natural clines in color and size become apparent.

Schwarz and Schwarz (1943) presented a simplified classification of house mice. By radical and in some cases arbitrary lumping, they reduced a list of 133 previously named kinds to 15 subspecies under *Mus musculus*. These subspecies they then arranged into four groups, which do not seem to have counterparts in any other system of mammalian classification. The groups are combinations of subspecies, but are themselves still below the specific level. Each group consists of a presumed wild ancestral subspecies together with "commensal" subspecies thought to have been derived from it. Such an arrangement has a certain appeal, because it presents a simple classification of a very complex group of animals and it offers an explanation for the confusing mixed populations that are found in some areas. It was adopted with minor reservations by Ellerman and Morrison-Scott (1951:603-609). We regret to say, however, that the scheme proposed by Schwarz and Schwarz seems to be more theoretical than real. It was based on the authors' ideas of relationships, which are conjectural and difficult, if not impossible, to prove or disprove. In working with collections of house mice from eastern Asia, including both old and new material, we repeatedly find that specimens studied bear little or no relation to this idealized classification.

Lawrence and Harriss (MS), working in west-central Korean areas that had been temporarily abandoned by native farmers because of military operations, wrote of this species as follows: "The house mouse was second to the field mouse, *Apodemus agrarius*, in relative abundance. . . . However, *Mus* did not occur in such a great variety of habitats but was concentrated along the margins of agricultural land, about former dwellings and along water courses."

The breeding season extends the year around, although there appear to be peaks in spring and again in late summer. The number of embryos per pregnant female ranged from 4 to 8 in our material.

Mus musculus molossinus Temminck

Mus molossinus Temminck, Fauna Japonica [Mammalia, pt. 4], p. 51, pl. 15, 1845. Type locality: Japan.

Mus musculus molossinus, Ellerman, The families and genera of living rodents, 2:248, March 21, 1941.

Distribution in Korea.—Known only from Cheju Do (Quelpart Island), possibly introduced there from Japan.

Measurements.—External measurements of three adults, two males and a female, from the vicinity of Mosulp'o are, respectively: Total length, 137, 137, 129; length of tail-vertebrae, 66, 65, 63; length of hind foot, 15, 16, 14; length of ear from notch, 13, 12, 13. For cranial measurements see Table 6.

Remarks.—For comparison with *M. m. yamashinai* of the Korean mainland see account of that subspecies. Our specimens are indistinguishable in color and in cranial features from house mice examined by us from Honshu, Japan. All three were trapped adjacent to, but not in, settlements.

Records of occurrence.—Specimens examined, 3, as follows: 1 mi. N Mosulp'o, 10 m., 2 (USNM 299247-48); 2 mi. SE Mosulp'o, 3 mi., 1 (USNM 299249).

Mus musculus utsuryonis Mori

Mus molossinus utsuryonis Mori, Jour. Chosen Nat. Hist. Soc., 23:16 (Japanese) and 17 (English), September 1, 1938. Type locality: Utsuro Island [= Ullung Do], Korea.

Mus musculus utsuryonis, Won and Woo, A distributional list of the Korean birds and mammals, p. 88, 1958.

Distribution in Korea.—Known only from Ullung Do.

Measurements.—External measurements listed by Mori (1938:18) for an adult male and an adult female, followed by those of two adult females from To-dong, Ullung Do (Won and Woo, 1956:17), are, respectively: Length of head and body, 71, 71, 80, 82; length of tail, 65, 66, 68, 78; length of hind foot, 17, 16, 17, 17.5; length of ear (probably from notch), 12.5, 12.5, 12, 12. For cranial measurements see Table 6.

Remarks.—Judging from the original description, *utsuryonis* is near *M. m. molossinus* in color; the the skull was said to be "similar" to that of *molossinus*. We have seen no specimens. Insofar as we know, this subspecies has not been mentioned by name in the literature since the original description save briefly by Kuroda (1940: 148) and by Won and Woo (1956:7, 17 and 1958*b*:88).

In the English text of the description, Mori recorded the holotype as a subadult male but in the table of measurements in both the Japanese and Engish descriptions an adult female is listed as the type.

Records of occurrence.—Specimens examined, none.
Additional record: To-dong (Won and Woo, 1956:17).

Mus musculus yamashinai Kuroda

Mus bactrianus yamashinai Kuroda, Jour. Mamm., 15:234, August 10, 1934. Type locality: Moppo [= Mokp'o], 30 ft., Korea.

Mus musculus yamashinai, Ellerman, The families and genera of living rodents, 2:248, March 21, 1941.

Mus kambei Kishida and Mori, Dobutsugaku Zasshi, 43:378, 1931. *Nomen nudum.*

Mus takakagii Kishida and Mori, Dobutsugaku Zasshi, 43:378, 1931. *Nomen nudum.*

Distribution in Korea.—Entire peninsula, except possibly extreme northern and northeastern parts, in both rural and urban areas.

Measurements.—Average and extreme external measurements of 10 adults (six males, four females) from west-central Korea are as follows: Total length, 135.2 (126-143); length of tail-vertebrae, 62.5 (59-68); length of hind foot, 15.8 (14-17); length of ear from notch, 13.0 (12.5-14.0). For cranial measurements see Table 6. Weights in grams of three adults, a male and two nonpregnant females, all from 5 mi. E Seoul, are, respectively: 11.7, 12.7, 13.9.

Remarks.—From *Mus musculus manchu*, geographically adjacent to the northward (specimens from Hsiaoling, 75 kilometers east of Harbin, and from the Sungaree River, 60 miles southwest of Kirin, Manchuria), *M. m. yamashinai* differs as follows: Underparts paler, never with heavy grayish wash; tail averaging considerably longer. Cranially the two subspecies resemble each other although comparisons suggest less bowed zygomatic arches and more inflated auditory bullae in *yamashinai*. From *Mus musculus molossinus* of Quelpart Island and Japan, *M. m. yamashinai* differs in having distinctly paler (more buffy) upper parts. We find no measurable cranial differences between *molossinus* from Quelpart Island and *yamashinai*. Schwarz and Schwarz (1943:68) and Ellerman and

TABLE 6.—CRANIAL MEASUREMENTS OF MUS MUSCULUS FROM KOREA

Catalogue number or number of specimens averaged, and sex	Occiptonasal length	Zygomatic breadth	Interorbital constriction	Breadth of braincase	Length of nasals	Length of incisive foramina	Length of maxillary tooth-row
Mus musculus yamashinai, several localities in west-central Korea							
Average 10 (6♂, 4♀)	20.1	10.7	3.5	9.5	7.1	4.7	3.5
Minimum	19.4	10.3	3.3	9.4	6.5	4.3	3.5
Maximum	20.6	11.2	3.6	9.7	7.4	5.0	3.6
Mus musculus molossinus, vicinity Mosulp'o, Cheju Do, Korea							
USNM 299247, ♀	....	10.4	3.3	9.4	....	4.6	3.5
USNM 299248, ♂	19.8	10.5	3.4	9.5	7.1	4.5	3.6
USNM 299249, ♂	20.2	10.8	3.5	9.5	7.0	4.6	3.7
Mus musculus utsuryonis, Ullung Do (after Mori, 1938:18)							
Holotype, ♀?	20.2	11.0	3.5	....	....	4.2	3.5

Morrison-Scott (1951:607) referred to house mice in Korea as *M. m. molossinus.*

Our Korean material seems most closely approached, both externally and cranially, among Oriental specimens seen by us, by mice from the coastal areas of North China (two miles southwest of Tangku and 80 miles east of Peking) referred to as *M. m. wagneri* by Schwarz and Schwarz (*op. cit.*:60) and by Ellerman and Morrison-Scott (*op. cit.*:608). Korean specimens differ measurably in both external and cranial features from mice taken on the Mongolian Plateau farther to the west.

Two specimens from Yongamp'o in extreme northwestern Korea were assigned to *yamashinai* in the original description and we tentatively follow this arrangement. These two specimens have slightly shorter tails than the average specimens from farther to the south, thus approaching *M. m. manchu.* Two specimens available to us from 180 miles up the Yalu River, on the Manchurian side, are intermediate in color and length of tail between *yamashinai* and *manchu*—if anything, closer to the latter. They were referred to *manchu* by Howell (1929:65). When specimens are available from northern and northeastern Korea they may be found to intergrade with *manchu* and perhaps will be best assigned to that subspecies.

One of five specimens from five miles east-northeast of Pusan is more tawny, both dorsally and ventrally, than other Korean specimens, perhaps reflecting the influence of introductions through that port city. Kuroda (1934:235) reported three specimens from Chi Do as being slightly paler than the type and other specimens of *yamashinai* from Mokp'o. One of two specimens from Ch'ongyang-ni is nearly as dark dorsally as specimens of *M. m. molossinus* from Cheju Do.

The catalogue number of the holotype of *M. m. yamashinai* (in the collection of the Yamashina Institute for Zoology and Ornithology, Tokyo, Japan) was reported as 122 in the original description, but the label attached to the holotype now bears the number 129.

Records of occurrence.—Specimens examined, 94, as follows: Changjon, 50 ft., 1 (YI 7); Chi Do (island), off Mokp'o, 3 (YI 142-144); Chip'o-ri, 150 m., 11 (USNM 294720-24, 298143-45, 299562-63, 301926); Ch'ongyang-ni, 2 (USNM 294726, 298196); Ch'onsong-ni, 2 (USNM 298197-98); 4 mi. W Ch'ungju, 100 m., 1 (USNM 298997); 7 mi. W Ch'ungju, 100 m., 1 (USNM 299561); Hant'anch'on Valley (approximately 7 mi. ESE Yonch'on), 2 (UMMZ 102511-12); Kumhwa, 3 (USNM 294727, 301279; YI 112); Kyangyang-ni, 1 (USNM 301281); Mokp'o, 30 ft., 3 (YI 124, 126, 129, including the holotype); Munsan-ni, 2 (CM—1 specimen; USNM 300452); 1 mi. N Oho-ri, 2 m., 1 (USNM 298988); Paju-ri, 2 (USNM 301283-84); Pusan, 3 (USNM 194110-12); 5 mi. ENE Pusan, 2 m., 5 (USNM 299241-45);

5 mi. E Seoul, 45 m., 24 (KU 60429-30, 63850-51, 67242; USNM 299560, 299564-76, 299578-81, 300652); Sinsul-li, 2 (USNM 298199-200); Sohung-ni, 1 (USNM 299613); Songu-ri, 1 (USNM 298206); Suwon, 27 m., 4 (MCZ 43406-07; USNM 299426, 301927); Taegwang-ni, 300 ft., 1 (KU 60433); ½ mi. SW Taegwang-ni, 1 (USNM 301928); T'ongjin, 1 (USNM 301282); Yonch'on, 7 (KU 67240-41; USNM 294725, 298201-03, 301280); 4 mi. S Yonch'on, 3 (USNM 294718-19, 298204); Yongamp'o, 2 (YI 1-2); central Korea, 4 (USNM 298205, 301285, 301929-30).

Additional records (Jones, MS, unless otherwise noted): Anju (Kuroda, 1938:74); Chinmokchong, 4 mi. N Ch'onan; Ch'orwon; Ori-dong (Lawrence and Harriss, MS); Seoul (Tokuda, 1941:153); 5 mi. W Tangjonggok.

SOME ZOOGEOGRAPHIC CONSIDERATIONS

The rodent-lagomorph fauna of Korea is depauperate in comparison with other regions at the same latitude in eastern Asia. Of the 18 species (*Petaurista leucogenys* is here discounted because we do not believe that it occurs in Korea), for example, only one, *Lepus coreanus,* bears distinct relationship to the endemic elements of the Chinese Province of the Palearctic. Evidently the mountains of Manchuria, especially the Khingan chain but to a lesser degree the mountains along the Korean-Manchurian border, have been effective barriers to dispersal of Chinese elements to the Korean Peninsula.

The rodents and lagomorphs of Korea comprise a mixture of kinds having boreal and temperate affinities, some of which (11 species) are widespread in the Palearctic Region and others of which (seven species) have restricted distributions in eastern Asia. The zoogeographic relationships of the 18 species here treated are summarized in Table 7.

If the system of zoogeographic classification proposed by Hershkovitz (1958) is used, 13 of the 18 species are endemic regionalites (or subregionalites of Hershkovitz's arrangement, because he regards the Palearctic and Nearctic as only subregions of the Holarctic Region) of the Palearctic. Four (*Clethrionomys rutilus,* which occurs also in the Nearctic; *Micromys minutus,* which ranges southward barely into the Oriental Region; and *Mus musculus* and *Rattus norvegicus*) are excurrent regionalites of the Palearctic. *Mus musculus* and *Rattus norvegicus* are provisionally placed in this category. Each seems to have affinities with faunas of temperate regions, and most authorities regard the two as having originated in Asia. Both species now have a nearly worldwide distribution, principally through transport by man, but we assume that both invaded at least the Oriental Region through natural means. The last species, *Rattus rattus,* is here regarded tentatively as an excurrent into the Palearctic from the Oriental Region.

The fauna of Korea bears little relationship to that of the south-

TABLE 7.—ZOOGEOGRAPHIC RELATIONSHIPS OF KOREAN LAGOMORPHS AND RODENTS

Species	Distribution in adjacent regions					Affinities				
	North China	Manchuria	Southeastern Siberia	Hokkaido, Japan	Southern Japan	Faunal relationship[1]	Widespread in Palearctic	Restricted to eastern Asia	Principally boreal in distribution	Principally temperate in distribution
LAGOMORPHA										
Ochotna hyperborea		X	X	X		P E R	X		X	
Lepus coreanus		?				P E R		X		X
Lepus mandshuricus		X	X			P E R		X	X	
RODENTIA										
Sciurus vulgaris	X	X	X	X		P E R	X		X	
Eutamias sibiricus	X	X	X	X		P E R	X		X	
Pteromys volans	X	X	X	X		P E R	X		X	
Cricetulus barabensis	X	X	X			P E R		X		X
Cricetulus triton	X	X	X			P E R		X		X
Clethrionomys rufocanus	X	X	X	X		P E R	X		X	
Clethrionomys rutilus		X	X	X		P Ex R	X		X	
Microtus fortis	X	X	X			P E R		X		X
Microtus mandarinus	X	?	?			P E R		X		X
Micromys minutus	X	X	X		X	P Ex R	X			X
Apodemus agrarius	X	X	X			P E R	X			X
Apodemus peninsulae	X	X	X			P E R		X		X
Rattus norvegicus	X	X	X	X	X	P Ex R	X			X
Rattus rattus	X	X	?	X	X	O Ex R	X		—[2]	—[2]
Mus musculus	X	X	X	X	X	P Ex R	X			X

1. Terminology after Hershkovitz (1958:588-591); abbreviations: P E R (Palearctic endemic regionalite), P Ex R (Palearctic excurrent regionalite), O Ex R (Oriental excurrent regionalite).

2. *R. rattus* appears to have tropical affinities.

ern islands (Honshu, Shikoku, and Kyushu) of Japan. Aside from *Mus musculus* and the two species of *Rattus*, the only species considered here that occurs also in southern Japan is *Micromys minutus*. Perhaps it is significant that *M. minutus* probably has the broadest natural distribution of any of the rodents of Korea, occurring from England and continental western Europe eastward to southeastern Siberia, China, Japan, and Formosa, and southward to Assam and the northern parts of Burma and Indo-China. This mouse evidently reached southern Japan at some time in the Pleistocene when the islands were connected with the Asiatic mainland *via* Hokkaido

and Sakhalin (although the species does not now occur on Hokkaido where biotic conditions are not unlike those in parts of southeastern Siberia where this species does occur). Jameson (1961:603) suggested a connection in the Pleistocene between Kyushu and the Korean Peninsula, *via* some of the islands in the Korean Strait, but we see little evidence of such a connection. For one thing, the relatively deep Korean Strait, about 60 fathoms at the shallowest place, argues against this view, as does the marked difference between the mammalian faunas of Korea and southern Japan.

Mammalian Distributional Areas

With regard principally to lagomorphs and rodents, but taking into account the entire mammalian fauna, Korea can be divided into two main distributional areas, one of which can be divided further into two districts.

Northern Highlands Distributional Area

This distributional area comprises the far northeastern part of Korea, the Kaima Plateau and surrounding mountains in the north-central part, and possibly extends southward along the relatively high mountains adjacent to the east coast to the northern part of the Taebaek Range. Most of the area lies above 3000 feet (up to more than 9000 feet on Paektu-san, on the Korean-Manchurian border) and most is (or was) covered with boreal forest. Many of the higher mountainous areas supported isolated glaciers in the Pleistocene.

Species herein discussed that are restricted in Korea to the Northern Highlands are *Ochotona hyperborea* and *Clethrionomys rutilus. Lepus mandshuricus,* although possibly not limited to this area, is a typical inhabitant. Subspecies of wide-ranging species that are more or less limited to this distributional area are *Eutamias sibiricus orientalis, Pteromys volans arsenjevi, Clethrionomys rufocanus arsenjevi, Microtus fortis pelliceus,* and *Apodemus agrarius mantchuricus.*

Peninsular-Insular Distributional Area

This area includes all of Korea not encompassed by the Northern Highlands, namely the lowlands of the northwest, the central and southern parts, and the adjacent islands, including Cheju Do. The area is characterized by the absence of the boreal elements that are restricted to the Northern Highlands, by *Microtus mandarinus,* and

by a number of southern and insular subspecies of wide-ranging species.

Deciduous and mixed forests formerly prevailed in this distributional area; most of the lowlands now are devoted to agricultural pursuits. Some mountains in southern Korea reach respectable heights (Chiri-san, 6283 feet, in the Sobaek Range, and Halla-san, 6398 feet, on Cheju Do, for example) but are isolated from the mountains of the north and do not support mammals typical of more northerly regions.

Two districts of the Peninsular-Insular Distributional Area are here recognized: 1) the Mainland and Adjacent Islands District (including Ullung Do), and 2) the Cheju Do District. The former differs from the latter in having a lagomorph (*Lepus coreanus*) and a number of species of rodents (three sciurids and three microtines, for example) that are not found on Cheju Do, and different subspecies of at least three species (*Apodemus agrarius, Micromys minutus,* and *Mus musculus*) that occur in both districts. The mammalian fauna of Cheju Do is typically Korean and the island obviously was connected with the mainland at some time in the Pleistocene. Cheju Do is of volcanic origin.

Won (1961:59-60) regarded Ullung Do [= Dagelet Island], an island in the Sea of Japan some 85 miles off the eastern coast of Korea, as belonging to the same faunal unit as the adjacent mainland, a point of view with which we agree. Ullung Do, a volcanic island, is separated from the mainland by depths of between 500 and 1000 fathoms (3000 to 6000 feet) and thus could not possibly have been connected with the peninsula in the Pleistocene. The known mammalian fauna of the island consists of six species (two bats, one shrew, and the three murine rodents that are commensals of man), all of which occur on the Korean mainland. The four non-volant kinds no doubt were introduced on Ullung Do. The two endemic subspecies, a shrew (*Crocidura suaveolens utsuryoensis*) and *Mus musculus utsuryonis,* are doubtfully distinct from subspecies occurring on the adjacent peninsula.

GAZETTEER

Excepting the few localities identified in text, the following list includes all geographic place-names in Korea used in the foregoing accounts. The names for which the precise latitude (north) and longitude (east) are given can be found in "Gazetteer to maps of Korea," 3 vols., AMS 2, U. S. Army Map Service, September, 1950, and can be located on the maps of AMS series L751 (1:50,000).

Most localities can be found also on the maps of AMS series L552 (Korea) and L542 (Manchuria), both 1:250,000. The McCune-Reischauer system of romanization of place-names is used.

The compilation of this gazetteer has spanned several years, and we have been able, through the help of colleagues in Japan and Korea, to locate nearly all place-names that have appeared in the literature with reference to lagomorphs or rodents in Korea. For those few names not precisely placed, we have ascertained at least approximate locations. Japanese (*italized*) and other names, including variant spellings, are listed parenthetically after some entries.

Anju (*Ansiu*). 39°37′, 125°40′

Central National Forest. A small mixed forest 15-18 mi. NE Seoul (see Kwangnung and Pup'yong-ni)

Ch'ail-bong (*Shanichiho, Shazitsuho*). 40°42′, 127°42′

Ch'angch'on. 37°46′, 128°24′

Chang-ni. 37°31′, 126°49′

Changjon (*Chian Zen, Chosen*). 38° 44′, 128°11′

Cheju. 33°31′, 126°31′

Cheju Do (Quelpart Island, *Saishu-to*). A large island in the East China Sea off the southern tip of Korea (see Cheju, Mosulp'o, and Sogwi-ri)

Chi Do (*Chi-to*). 35°04, 126°13′

Chigyong-dong. 38°14′, 127°21′

Chinbu-ri. 38°17′, 128°22′

Chinmokchong. 38°02′, 127°58′

Chip'o-ri. 38°08′, 127°19′

Chiri-san (Chili-san). 35°20′, 127°44′

Ch'onan (*Tenan*). 36°48′, 127°09′

Ch'ongju (*Seishu*). 36°38′, 127°29′

Chon'gong-ni. 38°01′, 127°04′

Ch'ongyang-ni. 38°15′, 127°23′

Ch'ongyang-ri (*Seiryo-ri*). Not exactly located, but in or near Seoul

Ch'onma-san. 37°41′, 127°16′

Ch'onsong-ni. 38°02′, 127°09′

Ch'orwon (Cholwon, *Tetsugen*). 38° 15′, 127°13′

Ch'unch'on. 37°53′, 127°43′

Chunggangjin (Chunkang-chin). 41° 47′, 126°52′

Ch'ungju. 36°58′, 127°57′

Chuuronjang (Juul, *Syuotsu, Syuotu*). 41°35′, 129°36′

Daichi-bei. Not exactly located, but approximately 42°25′, 129°45′; Won (1961) referred to this locality under the name Daichonmi

Hadong. 35°04′, 127°45′

Halla-san. 33°22′, 126°32′

Hamhung (*Kanko*). 39°55′, 127°32′

Hongch'on. 37°41′, 127°53′

Inch'on. 37°28′, 126°38′

Iksan-gun (*Ekisangun*). 36°00′, 127° 03′

Kaloguai. Not exactly located; listed as 55 mi. NE Seoul by Thomas (1907*b*:462)

Kangnung. 37°45′, 128°54′

Koyang-gun (*Koyo-gun*). Approximately 37°37′, 127°02′

Kuksa-bong. Not exactly located; probably the mountain by that name at 38°05′, 126°37′

Kumgang-san. Mountain range approximately 38°40′, 128°08′

Kumhwa (Kim-hoa, *Kim kua, Kinka*). 38°17′, 127°28′

Kunsan. 35°59′, 126°43′

Kwamno-bong (*Kamboho*). 41°28′, 129°01′

Kwangnung (*Korio, Koryo*). 37°45′, 127°11′

Kwangju (*Kosiu*). 35°09′, 126°55′

Kyangyang-ni. 37°51′, 126°49′

Kyonggi Province. The province in west-central Korea in which Seoul is located

Manp'o (*Bampo*). 42°20′, 130°32′
Mokp'o (*Moppo*). 34°47′, 126°23′
Mosulp'o. 33°13′, 126°15′
Mun'gyong (Min-gyong). 36°44′, 128°07′
Munsan-ni. 37°51′, 126°47′
Musan (*Mosan*). 42°13′, 129°13′
Nap'a-dong. 37°53′, 126°52′
Nongsa-dong (*Nojido*). 42°02′, 128° 49′
Oho-ri. 38°20′, 128°32′
Oji-ri. 38°10′, 127°14′
Ori-dong. 38°03′, 126°58′
Osan. 37°09′, 127°04′
Paektu-san (*Hakuto*). 42°00′, 128° 03′
Paju-ri. 37°50′, 126°49′
Pammol. 38°01′, 127°09′
Penchan. Not exactly located; listed as 50 mi. NE Seoul by Thomas (1907*b*:462)
Pochong. Not exactly located; approximately 41°31′, 128°18′
Potai-dong. Not exactly located; approximately 41°43′, 128°22′
P'ungsan-dong (*Hozando*). 42°09′, 129°22′
Pup'yong-ni. 37°44′, 127°12′
Pusan (*Fusan*). 35°08′, 129°04′
Ranto. 42°14′, 130°32′ (we are uncertain as to the Korean name for this island, but it may be Al-som)
Sa-dong. 37°29′, 130°54′
Sangbonch'on-ni. 37°27′, 127°16′
Seoul (*Keijo*). 37°30′, 127°00′
Sinsul-li. 38°10′, 127°25′
Sinuiju (*Shingisiu*). 40°05′, 124°23′
Soch'on-ni. 37°59′, 127°04′
Sogwi-ri (*Seikiho*). 33°15′, 126°34′
Sohung-ni. 38°11′, 128°13′
Songdong-ni. 38°01′, 127°16′
Songu-ri. 37°50′, 127°09′
Sorak-san (Solak-san). 38°07′, 128° 28′
Sosa. 37°29′, 126°47′
Sumil-li. 38°02′, 127°30′
Suwon. 37°17′, 127°01′
Taeam-dong (*Daigan-do*). 42°19′, 132°30′
Taegu (*Taiku, Taikyu*). 35°52′, 128° 35′
Taegwang-ni. 38°11′, 127°06′
Taehoesan-ni. 38°04′, 127°14′
Tangjonggok. 38°11′, 128°19′
To-dong (*Dodo*). 37°29′, 130°54′
Tokkum-ni. 38°09′, 127°06′
Toktun-ni. 37°58′, 127°07′
Tongbok (Tongpok). 35°04′, 127° 08′
Tongduch'on-ni. 37°56′, 127°03′
T'ongjin. 37°42′, 126°33′
Tongp'yongch'on. 37°59′, 127°02′
Tumen River. River that forms the northeastern border of Korea (with Manchuria and Soviet Siberia)
Ugu-dong. 38°18′, 127°23′
Ullung Do (Dagelet Island, *Utsuryo-to*). Small island in Sea of Japan off Korean east coast (see Sa-dong and To-dong)
Ulsan (*Urusan*). 35°33′, 129°19′
Unggi (*Yuki*). 42°21′, 130°24′
Unson-ni. 38°03′, 127°12′
Wach'o-ri. 38°08′, 127°05′
Wasu-ri. 38°14′, 127°27′
Wonju. 37°21′, 127°57′
Yalu River. River that forms the northwestern border of Korea (with Manchuria)
Yami-ri. 38°03′, 127°16′
Yanggu. 38°06′, 128°00′
Yangmun-ni. 38°00′, 127°15′
Yangwon-ni. 37°58′, 127°02′
Yonam-dong (*Engando, Yengan*). 41° 34′, 128°49′
Yonch'on. 38°06′, 127°04′
Yongamp'o (*Ryuganpo*). 39°57′, 124° 21′
Yongdungp'o. 37°31′, 126°55′
Yonggwang (*Reiko*). 35°16′, 126° 31′
Yongp'yong. 38°01′, 127°13′

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Mammals from Isla Cozumel, Mexico, With Description of a New Species of Harvest Mouse

BY

J. KNOX JONES, JR., AND TIMOTHY E. LAWLOR

Isla Cozumel, or Cozumel Island, lies in the Gulf of Mexico approximately 16 kilometers off the east coast of the Yucatan Peninsula. Administratively, the island is attached to the Mexican Territory of Quintana Roo. The strait that separates Cozumel from the mainland reaches a depth of more than 300 meters, and the current in the strait is swift. The island itself is approximately 45 kilometers long (northeast-southwest) and averages about 14 kilometers wide. "It is composed of limestone and its greatest elevation is about 10 meters above the sea" (Paynter, 1955:8). Vegetationally, Cozumel supports mostly scrubby deciduous forest and mangrove swamps.

From August 7 to 11, 1962, a field party from the Museum of Natural History of The University of Kansas collected vertebrate animals in the vicinity of San Miguel on the west coast of Cozumel. The present report concerns the mammals obtained or observed by the party, among which are several species previously unreported from the island. One of these is a new harvest mouse of the genus *Reithrodontomys* that is named and described beyond. Mention is made also of species previously reported from Cozumel, especially by Hall and Kelson (1959), Koopman (1959), Merriam (1901), and Thomas (1888).

Field operations on Cozumel were supported by funds made available through a contract (DA-49-193-MD-2215) between the U. S. Army's Medical Research and Development Command and The University of Kansas.

Didelphis marsupialis cozumelae Merriam, 1901.—Ten specimens (91428-37), including six pouch young, were taken 3½ km. N San Miguel, where opossums were seen nightly at a garbage dump. The female that carried the six young was obtained on August 8; the young weighed an average of 18.4 (17.6-19.5) grams.

We tentatively retain the subspecific name *cozumelae* for the insular opossums. Comparison of our material with specimens of *D. m. yucatanensis* from the adjacent mainland fails to support Merriam's (1901:102) contention that the two differ in certain cranial features or that *cozumelae* is the larger in size of body. The tail does, however, average shorter in relation to length of

body than in specimens from the mainland, and the white tip on the tail is noticeably shorter (one-half to two-thirds as long).

Selected measurements of an adult male and the largest available female (the one with young) are, respectively: total length, 770, 633; length of tail, 319, 300; length of hind foot, 60, 53; length of ear, 54, 52; greatest length of skull, 115.1, 90.7; zygomatic breadth, 63.5, 45.2; palatal length, 65.7, 54.8; length of M1-M4, 19.5, 17.9.

Micronycteris megalotis mexicana Miller, 1898.—Our only specimen (91539), a female in juvenal pelage and with unfused phalangeal epiphyses, was taken in a mist net stretched between two palm trees adjacent to the cottage in which we stayed. Goldman (1951:443) earlier listed this species from Cozumel under the name *Macrotus pygmaeus*.

Artibeus jamaicensis yucatanicus J. A. Allen, 1904.—Judging from our experience, this species is the commonest of the bats occurring on Cozumel. Eighteen individuals were collected as follows: 4 km. N San Miguel, 6 (91724-29); 3½ km. N San Miguel, 12 (91730-40, 91781). All specimens taken were netted, either along small roads through the scrubby forest or among coconut palms adjacent to residences near the beach. Five of 11 females obtained were lactating; the testes of one male measured 10 mm. Several authors previously have reported this bat from the island.

Artibeus lituratus palmarum Allen and Chapman, 1897.—One specimen (91780), a male having testes measuring 6 mm., was netted along with several individuals of *A. jamaicensis* among coconut palms 3½ km. N San Miguel. This species has not been reported previously from Cozumel.

Artibeus phaeotis phaeotis (Miller, 1902).—A male and two females of this small fruit-eating bat were trapped in mist nets stretched across a narrow road in the forest 4 km. N (91790) and 3½ km. N (91791-92) San Miguel. Each of the females carried a single embryo (23 and 25 mm. crown-rump). Although this species long has been known from the Yucatan Peninsula, it was not formerly known from Cozumel.

Previous authors (Hershkovitz, 1949:449, Dalquest, 1953:64, and Davis, 1958:164, among others) have regarded *A. p. phaeotis* (type locality, Chichén-Itzá, Yucatán) as a subspecies of *Artibeus cinereus*. Apparently none of the authors who thus treated *phaeotis* examined the holotype, which actually is identical with the species later described by Andersen (1906:422) as *Artibeus turpis* (type locality, Teapa, Tabasco). Therefore, *A. p. phaeotis* replaces *A. t. turpis* as the correct name for the bat of the Caribbean lowlands of southern Mexico and adjacent areas that is characterized by its small size, relatively broad and naked uropatagium, and short, up-turned rostrum. The slightly smaller subspecies of Pacific coastal areas (see Davis, 1958:163) henceforth should bear the name *Artibeus phaeotis nanus*.

We are grateful to Dr. C. O. Handley, Jr., of the U. S. National Museum, who currently is revising the genus *Artibeus*, for allowing one of us (Jones) to examine the holotype of *phaeotis*. Our attention first was drawn to this matter when we discovered that all individuals of small *Artibeus* in our collection from the Yucatan Peninsula resembled *"turpis,"* which was not reported from there, rather than *"cinereus,"* which was said to occur there.

Measurements of the male and two females are, respectively: total length, 57, 54, 58; length of hind foot, 12, 10, 11; length of ear, 14, 16, 17; length of

forearm, 38.2, 38.3, 40.8; greatest length of skull, 19.6, 19.1, 19.3; zygomatic breadth, 11.5, 11.7, 11.7; length of maxillary tooth-row, 6.0, 5.8, 5.9.

Natalus stramineus saturatus Dalquest and Hall, 1949.—This species, previously unreported from the island, is represented in the U. S. National Museum by 32 specimens in alcohol from San Miguel.

Oryzomys palustris cozumelae Merriam, 1901.—Rice rats were abundant in tangled, second-growth brush and vines. Thirty-six specimens were collected from 3 km. N (92185-86) and 3½ km. N (92168-84, 92187-203) San Miguel. A female obtained on August 8 carried three embryos that measured 15 mm. (crown-rump) and our sample contains many two-thirds to three-fourths grown young.

Up to now, *O. p. cozumelae* has been regarded as a distinct species, although its close relationship with *O. palustris* of the adjacent mainland has been recognized (see Goldman, 1918:43). None of the specimens among our material are as large as the holotype of *cozumelae,* but a number fall within the range of variation cited for adults by Goldman (*loc. cit.*). When our specimens were compared with individuals of *O. p. coucsi* from the Yucatan Peninsula, we found that *cozumelae* differed noticeably only in being larger externally; cranially, *couesi* and *cozumelae* differ only in minor details (for example, the skull of *cozumelae* averages slightly larger, is less arched over the orbits, and has heavier teeth and larger nasals), and the latter averages only slightly darker than mainland specimens. Furthermore, adults of *cozumelae* do not exceed in external size individuals from several of the named populations of *O. palustris.* For all these reasons, and because *cozumelae* long has been recognized as only an insular relative of *palustris,* we employ the name *Oryzomys palustris cozumelae* for it. We feel the relationships of the insular population are best reflected by such usage.

Reithrodontomys spectabilis new species

Holotype.—Adult male, skin and skull, no. 92294 Museum of Natural History, The University of Kansas, from 2½ km. N San Miguel, Isla Cozumel, Quintana Roo; obtained by Ticul Alvarez on August 8, 1962 (original no. 848).

Distribution.—Known only from Cozumel Island.

Diagnosis.—Size large both externally and cranially (see measurements); tail long in relation to head and body (134-148 per cent in adults), scantily haired; pelage short and relatively sparse; upper parts brownish ochraceous over-all, brighter ochraceous on sides; underparts grayish white, the individual hairs white terminally and plumbeous basally; pinkish buff pectoral spot sometimes present; tail dark brown above, only slightly paler below; braincase relatively flattened and uninflated; zygomatic arches broad and strong; rostrum relatively short and broad; mesopterygoid fossa broad; auditory bullae large but only moderately inflated; incisive foramina rarely reaching level of M1; teeth large; first and second molars typical of the subgenus *Aporodon* in having well developed mesolophs(ids) and mesostyles(ids); third lower molar essentially a smaller replica of first two; baculum long (9.5 and 10.9 mm. in two adult males), slender, curved dorsally at the distal end, broadly arrow-shaped basally (width of base 1.1 and 1.2 mm. in the two adult bacula studied), possibly largest among members of genus. The skull and teeth are illustrated in Figure 1.

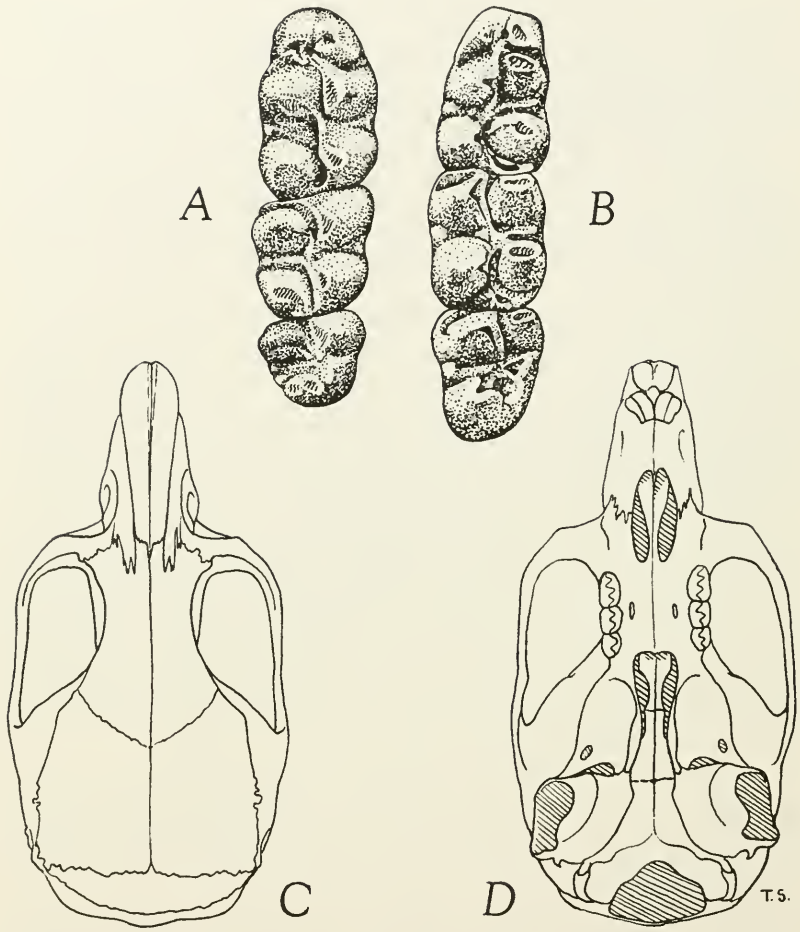

Fig. 1. Skull and teeth of *Reithrodontomys spectabilis*. Right upper (A) and left lower (B) molars of KU 92293 (× 15), and dorsal (C) and ventral (D) views of skull of holotype, KU 92294 (× 3). T. H. Swearingen made the drawings from photographs by J. F. Downhower.

Measurements.—External and cranial measurements of the holotype followed by average and (in parentheses) extreme measurements of eight specimens (four males and four females, including the type) are: total length, 216, 213.8 (205-221); length of tail, 124, 125.7 (121-132); length of hind foot, 22, 21.3 (20-22); weight (in grams), 20.6, 20.2 (18.1-21.4); greatest length of skull, 24.7, 25.2 (24.6-26.2); zygomatic breadth, 12.2, 12.3 (11.8-12.7); interorbital breadth, 3.7, 3.7 (3.5-3.9); breadth of braincase, 11.2, 11.2 (11.0-11.5); depth of skull, 8.5, 9.0 (8.5-9.4); length of rostrum, 8.8, 9.0 (8.7-9.8); breadth of rostrum, 4.1, 4.2 (3.9-4.5); length of incisive foramen, 4.4, 4.5 (4.4-4.8); breadth of mesopterygoid fossa, 1.7, 1.7 (1.5-1.8); length of palatal bridge, 3.9, 4.0 (3.8-4.3); alveolar length of maxillary tooth-row, 3.8, 3.8 (3.7-3.9); alveolar length of mandibular tooth-row, 3.4, 3.5 (3.4-3.7).

Comparisons.—The new species is a member of the subgenus *Aporodon* and is allied to *Reithrodontomys mexicanus* and *R. gracilis* of the *R. mexicanus* species group. It is the largest member of the *mexicanus* group as defined by Hooper (1952) and among the largest species of the genus *Reithrodontomys.*

Of the two kinds to which it appears most closely related, the new species resembles *R. gracilis* of the adjacent mainland of the Yucatan Peninsula to a somewhat greater degree than *R. mexicanus,* known nearest Cozumel Island from the highlands of Guatemala and Honduras. In comparison with *gracilis, R. spectabilis* is immediately recognized by its much larger size (total length averaging 213.8 in adult *spectabilis* but only 175.7 in six adult *R. g. gracilis* from the Yucatan Peninsula, length of hind foot 21.3 and 17.8, greatest length of skull 24.7 and 21.9, zygomatic breadth 12.2 and 10.8), generally darker coloration, and in having a massive skull with broader, heavier zygomatic arches. *R. spectabilis* resembles *R. gracilis* (in contrast to *R. mexicanus*) in that the dark tarsal stripe does not extend onto the hind foot and in having a flattened and relatively uninflated braincase, incisive foramina that rarely reach the level of M1, and in other general features of the cranium. The breadth and depth of the braincase are even less, relative to length of the skull, than in *gracilis*—the breadth averages 44.6 per cent of the greatest length of skull (47.5 in *gracilis* studied), and the depth of skull averages 35.9 in relation to length (36.9 in *gracilis*).

R. spectabilis resembles *R. mexicanus* more than *R. gracilis* in size (measurements of *mexicanus* studied—subspecies *howelli* and *orinus*—are intermediate between those of *spectabilis* and *gracilis*) and to some extent in general coloration. Cranially, aside from averaging smaller, *mexicanus* can be distinguished most easily from *spectabilis* by its proportionately broader and deeper braincase.

Because of its resemblance in many features to the smaller *R. gracilis,* we assume that the precursors of *R. spectabilis* reached Cozumel from the adjacent mainland of the Yucatan Peninsula. The magnitude of the differences between the two species suggests, to us at least, that they have been separated for a relatively long time, since at least late Pleistocene.

Remarks.—Some of the harvest mice from Cozumel Island were trapped in tangled, second-growth vines and brush adjacent to (beachward from) scrub forest; *Oryzomys palustris cozumelae* was abundant in this same habitat. Other individuals were taken in forest in traps set at the bases of trees and along a stone wall. One specimen was caught by hand at night as it climbed in the branches of a small tree, indicating that the Cozumel harvest mouse is at least partly arboreal in habits.

Our sample contains several juvenal and subadult specimens. One female, trapped on August 9, had been recently lactating, but no other females evidenced gross reproductive activity. The testes of two adult males measured 13 and 14 mm.

Specimens examined, 16, as follows: 2½ km. N San Miguel, 3 (92294-96); 3½ km. N San Miguel, 13 (92281-93).

Peromyscus leucopus cozumelae Merriam, 1901.—Six white-footed mice were trapped along trails in scrub forest or in places marginal between forest

and second-growth brush. Our specimens are from 3½ km. N (92417-21) and 2½ km. N (92422) San Miguel. A female obtained on August 11 was lactating.

P. l. cozumelae differs from the subspecies of the mainland of the Yucatan Peninsula (*P. l. castaneus*) in being larger, both externally and cranially, and in having heavier teeth. The two kinds closely resemble each other in color.

Dasyprocta punctata yucatanica Goldman, 1913.—According to Merriam (1901:100), *D. punctata* was introduced on Cozumel "shortly before" the visit of Nelson and Goldman to the island in 1901. Goldman actually observed an individual in the forest near San Miguel. Natives reported to us that agoutis still occur on the island.

Agouti paca subsp.—On the morning of August 11, William E. Duellman observed a paca along a trail through the forest approximately 4 km. N San Miguel. We queried local residents concerning the status of this large rodent on the island and, while aware of its presence, they had no knowledge of whether or not it had been introduced.

Urocyon cinereoargenteus subsp.—We did not obtain specimens of the gray fox, but local residents reported its occurrence to us. Earlier, Merriam (1901:99) wrote of this species on Cozumel as follows: "The only mammal heard of [by Nelson and Goldman] which was not secured is a small Gray Fox (*Urocyon*) reported by natives as rather rare, but more common on the eastern and southern parts of the island. From the accounts it agrees with the Raccoon, Nasua, and Peccary in being much smaller than the mainland species."

Procyon pygmaeus Merriam, 1901.—A subadult male raccoon (92565) was shot on August 8 from a coconut palm situated along the beach 3½ km. N San Miguel. Two other individuals were seen in the same tree and the three may have been from the same family group. Our specimen differs in cranial features from raccoons of the Yucatan Peninsula (*P. lotor shufeldti*) in ways described by Goldman (1950:76-77), and we follow Goldman in preserving specific recognition for *pygmaeus*. It is perhaps worthy of note that our specimen has a distinct "interparietal" bone approximately 13 mm. long by 8 mm. wide, at the juncture of the parietal and frontal bones.

Nasua nelsoni Merriam, 1901.—According to local residents, coatis are common in the vicinity of San Miguel. Several were seen at night and in early morning by our party. One (92570), an adult female with well-developed teats (probably recently lactating), was obtained 3½ km. N San Miguel.

We retain *N. nelsoni* as a full species because it differs so strikingly in size from the coati (*Nasua narica yucatanica*) of the adjacent mainland. Measurements of our specimen, followed in parentheses by measurements of an adult female of *yucatanica* from 7 km. N and 51 km. E Escárcega, Campeche, are as follows: total length, 741 (990); length of tail, 332 (485); length of hind foot, 76 (99); length of ear, 35 (40); greatest length of skull, 103.4 (118.6); zygomatic breadth, 50.3 (58.3); interorbital constriction, 20.4 (24.5); palatal length, 62.7 (72.9); breadth of braincase, 38.3 (42.0); alveolar length M1-M3, 16.6 (19.9). Aside from its over-all smaller size, the skull of *nelsoni* is notable for its more delicate construction and distinctly smaller bullae when compared with *N. n. yucatanica*.

Trichechus manatus manatus Linnaeus, 1758.—Local residents reported that manatees were observed occasionally along the west coast of the island and that they were common in the bays and lagoons on the adjacent coast of Quintana Roo.

Tayassu tajacu nanus Merriam, 1901.—The collared peccary of Cozumel was described as a subspecies distinct from that on the adjacent mainland of Yucatan (*T. t. angulatus*) on the basis of smaller size and blacker nose and chin. Subsequently, Hershkovitz (1951:567) noted that the species had been introduced on the island from the adjacent mainland (see also de Vos *et al.*, 1956:176) and suggested that the small size claimed for *nanus* resulted from heavy hunting pressure, which did not allow animals to attain adult size. Additional specimens are needed before Hershkovitz's interesting hypothesis can be tested. Natives on Cozumel reported the collared peccary as common and intensively hunted.

Mammals Reportedly Collected on Cozumel by G. F. Gaumer

George F. Gaumer, well-known naturalist who lived for many years on the Yucatan Peninsula, reported himself, or sent to others, a number of mammals alleged to have come from the island of Cozumel. Some of these probably originated from the island but others seemingly did not, as discussed below.

Oldfield Thomas (1888), in the first technical paper dealing with mammals from Cozumel, reported five species that were collected by Gaumer and communicated to Thomas by Salvin and Godman. These five were *Didelphis marsupialis, Pteronotus parnellii, Artibeus jamaicensis, Tadarida laticaudata,* and *"Nasua nasica."* The opossum, Jamaican fruit-eating bat, and coati (in the form of the small *Nasua nelsoni*) subsequently have been found to be common on the island. No other records of the two remaining bats, *Pteronotus* and *Tadarida,* have been forthcoming, but each is widespread on the adjacent Yucatan Peninsula and we do not doubt that each occurs on Cozumel.

In his "Monografía de los mamíferos de Yucatán," Gaumer (1917:117) reported the presence of the Yucatan deer mouse, *Peromyscus yucatanicus,* on the island. He did not, however, record *Peromyscus leucopus* from Cozumel and Koopman (1959:237) concluded that Gaumer confused the two species. We are inclined to agree with Koopman, because insofar as we know *P. yucatanicus* does not occur on the island. Gaumer (*op. cit.*:63) also recorded the white-lipped peccary (as *"Dicotyles labiatus"*) from Cozumel but this, too, seems to be in error.

By far the most perplexing collection of mammals relating to Cozumel is a lot of specimens acquired from Gaumer by the Museum of Natural History in the early 1900's. Many of these specimens were cited by Hall and Kelson (1959) and all species represented were listed by Koopman (1959). The holotype and paratypes of *Mimon cozumelae* Goldman (1914) were among the specimens in this collection. Aside from *M. cozumelae,* species represented (and their catalogue numbers) are: *Micronycteris megalotis mexicana* (1659-60); *Glossophaga soricina leachii* (1655-58); *Artibeus jamaicensis yucatanicus* (1641-42); *Centurio senex* (1669-70); *Lasiurus borealis teliotis* (1655); *Plecotus* (possibly *mexicanus*) (1658); *Molossus ater nigricans* (1663-64); *Ateles geoffroyi yucatanensis* (885); *Tamandua tetradactyla mexicana* (869-872, 880); *Heterogeomys hispidus yucatanensis* (1370); *Nasua narica yucatanica* (876-77, 1599-1600); *Galictis allamandi canaster* (873); and *Tayassu* sp. (875—said to be *T. t. nanus,* probably solely on supposed geographic grounds, but specimen not now to be found).

Most of the labels that now accompany the above-listed specimens are not the original labels of Gaumer, and, in any event, bear no additional information that could support or refute the contention that the specimens actually

came from Cozumel. Many other specimens received at the same time are labeled simply as from "Yucatan." Some of the specimens said to be from Cozumel obviously did not come from there as shown below and there is a strong possibility that others did not. Perhaps few or none of the specimens actually originated on the island.

Of the eight bats, only two (*A. jamaicensis* and *M. megalotis*) have been obtained on Cozumel by other collectors. One, *Plecotus,* seems likely not to occur there (see also Koopman, 1959:237). The remaining five (*Mimon, Glossophaga, Centurio, Lasiurus,* and *Molossus*) are widespread in Middle America and each is known from the adjacent mainland. We took *G. soricina* on the much smaller Isla Mujeres that lies to the north of Cozumel. There is a strong possibility that all five species actually occur on Cozumel and that additional collecting will establish their presence on the island. We are especially hopeful of this development with reference to *Mimon cozumelae.*

With reference to the six strictly terrestrial kinds, we doubt that any save *Tayassu* occurs on the island. The major habitat, scrub forest, doubtfully would support tamanduas or monkeys (although the latter might have been introduced) and neither was reported to us by local residents (nor was the grison mentioned). We especially questioned natives about the occurrence of pocket gophers but they assured us that "tuzas" were not present. All four coatis, formerly labeled "*Nasua nelsoni,*" are unquestionably the much larger *N. narica yucatanica* that occurs only on the adjacent mainland.

Zoogeography

As Koopman (1959) pointed out, the zoogeographic relationships of Cozumel, at least with respect to mammals, are undoubtedly with the adjacent mainland, not with the Antilles. Even though the strait that separates Cozumel from the mainland of Quintana Roo is deep, and the current in it strong, we suppose that most of the mammals that occur on the island reached it by "rafting" across the strait or possibly from the mainland to the south of Cozumel. At a time of maximal glaciation, because of a lowering of the sea level, the strait would have been reduced to approximately half its present width, theoretically making "rafting" much easier than now, especially if favorable winds prevailed. At least three of the mammals that currently inhabit the island are known or suspected to have been introduced by man.

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The Yucatan Deer Mouse, Peromyscus yucatanicus

BY

TIMOTHY E. LAWLOR

University of Kansas
Lawrence
1965

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INTRODUCTION

Peromyscus yucatanicus was named and described by Allen and Chapman (1897:8) on the basis of six specimens from Chichén-Itzá, Yucatán. Few specimens were available for study until 1962 and 1963 in which years more than 100 were obtained. Specimens from certain parts of the supposed geographic range of the species still are wanting but enough are at hand to permit a meaningful analysis of geographic variation in the species.

The objectives of my study were to: 1) ascertain the characteristics of *Peromyscus yucatanicus* as compared with closely related species; 2) analyze geographic variation within the species and assess its taxonomic significance; 3) summarize available information concerning natural history; and 4) provide evidence relating to origin and evolution of the species.

MATERIALS, METHODS, AND ACKNOWLEDGMENTS

Unless otherwise indicated, specimens studied are in the Museum of Natural History of The University of Kansas. Others were borrowed from the American Museum of Natural History (AMNH), the Biological Surveys Collection in the United States National Museum (USNM), and the Museum of Zoology of the University of Michigan (UMMZ). Also some specimens of *Peromyscus mexicanus* for comparison with *P. yucatanicus* were borrowed from the Chicago Natural History Museum.

In all, 213 specimens of *P. yucatanicus* were studied. They were grouped by sex, age, and geographic origin, so that individual variation could be assessed prior to study of geographic variation. In the following account males and females are grouped together for purposes of analysis because secondary sexual variation proved to be insignificant.

External measurements employed are those recorded on specimen labels. The mastoid breadth as measured by me is the greatest distance across the mastoid bones perpendicular to the long axis of the skull. The manner in which other cranial measurements were taken is explained by Hoffmeister (1951:28) and Hooper (1952:9-11).

The baculum of *P. yucatanicus* has a characteristic configuration (see Fig. 1C). Length of the baculum was measured from the posteriormost border of the base of the bone to the anteriormost point on the tip of the bone, and its (greatest) breadth was measured across the base perpendicular to the long axis of the baculum.

Variation in color was recorded by a Photovolt Photoelectric Reflection Meter, Model 610, on which measurements are recorded as a percentage value of pure white. Readings were made for each of three color reflections—red, green, and blue—and were taken from specimens at the middorsal region of the back. Measurements of reflected wave lengths of red and green proved to be geographically variable, but reflections of blue did not vary significantly.

For the loan of specimens I am indebted to Drs. S. Anderson of The American Museum of Natural History, E. T. Hooper of the Museum of Zoology of the University of Michigan, R. H. Manville of the Biological Surveys Collection of the U. S. Fish and Wildlife Service, and J. C. Moore of the Chicago Natural History Museum. Cost of collecting the specimens of *P. yucatanicus* in the Museum of Natural History was met by a contract (DA-49-193-MD-2215) from the Medical Research and Development Command of the U. S. Army and by the Kansas University Endowment Association.

I am especially grateful to Dr. J. Knox Jones, Jr., for providing me with guidance during the study and for critical assistance with my manuscript. Dr. William E. Duellman also criticized parts of the manuscript.

TAXONOMIC RELATIONSHIPS

Peromyscus yucatanicus resembles *Peromyscus boylii* in color and size, but the species are allopatric. Furthermore, *P. boylii* has a well-haired tail, a rounded and inflated braincase, and a non-beaded supraorbital border as compared with the rather naked, blotchy tail, uninflated braincase, and beaded supraorbital ridge of *P. yucatanicus*. Similarly, *P. banderanus* approaches *yucatanicus* in certain cranial characteristics and in coloration, but the two species are disjunct geographically and *yucatanicus* differs from *banderanus* in having a less beaded skull, a longer, more slender, distinctive baculum (see Hooper, 1958:13 and 18), and in being smaller externally and cranially. The range of *P. yucatanicus* overlaps that of the white-footed mouse, *Peromyscus leucopus,* but the latter mouse can

be distinguished easily by its smaller size, shorter, non-beaded skull, and well-haired, bicolored tail.

Of all known species, *Peromyscus mexicanus* most closely resembles *P. yucatanicus.* Osgood (1909:212) stated that "although quite distinct, this species [*P. yucatanicus*] is little more than a miniature of *P. mexicanus.*" The smaller size of *P. yucatanicus* is the only readily apparent difference between the two kinds. The two species are allopatric, but the distance between the known locality of occurrence of *P. mexicanus teapensis* (six miles southeast of Palenque, Chiapas) nearest that of *yucatanicus* (seven and one-half kilometers west of Escárcega, Campeche) is only 175 kilometers. It was recognized that the gap could be due to inadequate collecting in the intervening area, and that *P. yucatanicus* possibly was simply a small peninsular representative of *P. mexicanus.* Kuns and Tashian (1954:102) reported that the eleven specimens of *mexicanus* from six miles southeast of Palenque, in northern Chiapas, which they tentatively referred to *P. m. teapensis,* were smaller than typical representatives of the subspecies. Examination of these specimens in connection with the present report, however, revealed no significant differences in size from specimens of *P. m. teapensis* in the collection of the Museum of Natural History, and, therefore, no hint of intergradation with *yucatanicus.* That intergradation does not occur between the two species is evidenced, in part, by the fact that the smallest representatives of *yucatanicus* occur in that part of the range nearest the geographic range of the larger *mexicanus.* Moreover, results of a detailed study of the morphology of *P. yucatanicus* and *P. mexicanus* indicate that they are distinct species.

Skull.—*P. yucatanicus* is smaller than *P. mexicanus,* and has on the average a somewhat less beaded supraorbital ridge. The skulls of the two species closely resemble each other in being elongate and narrow, and in having small auditory bullae.

Teeth.—Both species have small, stocky premolars and molars, but the molars of *P. yucatanicus* are more complex. The accessory ridges (mesolophs of Hooper, 1957:9) are well developed and fused with the labial styles (mesostyles of Hooper, *loc. cit.*) whereas in *P. mexicanus* the accessory ridges are reduced and are incompletely or not at all fused with the styles (Hooper, 1957:36). The same condition obtains in the lower molars. The patterns proved to be constant in *P. yucatanicus* and *P. m. teapensis,* in all specimens

with unworn teeth that were examined. The dental topography of the two species is illustrated in Figure 1.

Baculum.—The baculum in most specimens of *mexicanus* is noticeably curved ventrally whereas it is straight or only slightly curved ventrally in *P. yucatanicus.* The degree of curvature may be an artifact of preparation. The baculum of *yucatanicus,* although smaller than that of *mexicanus,* is larger in relation to the length of the body, and the base is wider in relation to the length of the bone. The bacula of *yucatanicus* and *mexicanus* are illustrated in Figure 2.

Hyoid apparatus.—Although smaller, the hyoid apparatus of *P. yucatanicus* is essentially like that of *P. mexicanus* in configuration. The entoglossal process of the basihyal bone seems to project slightly farther anteriorly in *yucatanicus.*

Auditory ossicles.—The ear ossicles of the two species are similar although the malleus, incus, and stapes of *yucatanicus* are smaller.

Hairiness of tail.—The tails of both species are sparsely haired and have concentric scales (or rings) overlapping distally and resembling paper cups placed one within another. Hairs extend posteriorly in groups of three from the surface of each scale at the point of farthest overlap of the preceding scale. Each group comprises one long center hair and two short outer hairs; the center hair is approximately three scale widths in length, and the shorter hairs are about two scale widths in length. In *yucatanicus* the individual hairs on the tail are wider and the groups of hairs are situated closer together.

NON-GEOGRAPHIC VARIATION

The results of my detailed study of variation owing to age, secondary sexual features, and individualism (measurements available in a dissertation filed in the University of Kansas Library) were essential in recognizing geographic variation but are not recorded here because they do not differ significantly from the published results of previous studies of other species of *Peromyscus* by other workers. Hoffmeister (1951), for example, has recorded such data for *Peromyscus truei.*

Post-juvenal molt (from juvenal to subadult pelage) and post-subadult molt (to adult pelage) of *Peromyscus yucatanicus* are similar to those of *P. truei* (Hoffmeister, 1951:4-5), *P. boylii* (Brown, 1963:467-468), and *P. maniculatus gambeli* (Collins, 1918:76-78 and 1923:58-63), and therefore a detailed description of the several molts in *Peromyscus yucatanicus* is not included in this report.

Juvenal pelage is a drab gray, and resembles the same pelage in other species of *Peromyscus.* A pale gray pelage in several young specimens appeared to be intermediate between typical juvenal and subadult pelages. It

may well be that another rather ill-defined molt and pelage occurs between the juvenal and subadult pelages in this species, as was suggested by Hoffmeister (1951:5-6) for *P. truei*.

Adult and subadult pelages were not always easily separable. In general, the adult pelage is a brighter ochraceous on the sides and dorsum, the ochraceous subterminal bands of the guard hairs being long. The underparts are yellowish white, and the hairs are often pure white or yellow, lacking a dark band. Subadult pelage is more dusky dorsally, the dark terminal band being long and the subterminal band short. The underparts are pale grayish with little or no admixture of yellow.

In adults seasonal molts are not so easily defined as are post-juvenal and post-subadult molts, and appear to be irregular in pattern and somewhat atypical of molt described for other species of the genus. Adults molt twice each year, once in spring and once in autumn. In theory two molts per year would seem to be unnecessary in mice inhabiting tropical climates. The distinct wet and dry seasons of the Yucatán Penisula may provide the environmental stimulus for two seasonal molts in *P. yucatanicus*, or, more probably, the evolutionary conservativeness of molt sequence has led to retention of an autumnal and a spring molt.

Readings of reflection of red and green wave lengths were taken for individual specimens according to season. In general, winter pelage of adults is paler than summer pelage. Mean readings of color reflection from both seasonal pelages from three areas within the range of *P. yucatanicus* are given in Table 1.

TABLE 1.—AVERAGE COLOR REFLECTION READINGS OF RED AND GREEN WAVE LENGTHS FOR SUMMER AND WINTER PELAGE OF P. YUCATANICUS FROM THREE AREAS ON THE YUCATAN PENINSULA.

LOCALITY	Summer			Winter		
	N	Red	Green	N	Red	Green
Northeastern Quintana Roo	2	10.7	6.7	12	14.6	7.0
Central Yucatán	11	11.6	6.3	11	12.0	6.3
Southwestern Campeche	5	7.9	4.4	27	10.6	5.5

GEOGRAPHIC VARIATION

The Yucatán Peninsula is a relatively flat limestone plain, devoid of major topographic features, and for the most part lacks permanent surface drainage. Paynter (1955:10) characterized the climate as "tropical, with a relatively constant average temperature throughout the year, and with moderately pronounced dry and rainy seasons." The vegetation varies from xerophilous scrub on the northern coast to quasi-rain forest in the central and southern parts.

TABLE 2.—AVERAGE (AND EXTREME) EXTERNAL AND CRANIAL MEASUREMENTS OF PEROMYSCUS YUCATANICUS FROM SELECTED LOCALITIES ON THE YUCATAN PENINSULA. PARENTHETICAL NUMBERS FOLLOWING NAMES OF LOCALITIES IDENTIFY THE LOCALITIES ON THE DISTRIBUTION MAP, FIGURE 2.

N	Total length	Length of tail	Length of hind foot	Greatest length of skull	Zygomatic breadth	Length of rostrum	Breadth of braincase	Length of incisive foramen
				7 km. N, 51 km. E Escárcega (1)				
10	192.0 (185.0–200.0)	93.4 (88.0– 97.0)	21.6 (21.0–22.0)	28.1 (27.3–28.8)	13.6 (13.1–14.1)	10.6 (9.7–11.0)	12.3 (12.1–12.5)	5.8 (5.1–6.2)
				7½ km. W Escárcega (2)				
5	206.6 (202.0–221.0)	100.2 (95.0–107.0)	21.8 (21.0–23.0)	28.5 (27.9–29.0)	14.0 (13.3–14.7)	10.9 (10.2–11.5)	12.3 (12.1–12.6)	5.8 (5.4–6.2)
				Apazote (3)				
14	190.8 (181.0–203.0)	94.5 (84.0–105.0)	23.6 (23.0–24.0)	27.5 (26.3–28.8)	13.0 (12.3–14.0)	10.6 (10.0–11.4)	12.3 (11.6–12.7)	5.5 (5.1–5.8)
				Mérida Airport, 6 km. S Mérida (5)				
6	193.6 (185.0–201.0)	97.4 (90.0–105.0)	21.8 (21.0–22.5)	28.3 (27.7–28.7)	13.5 (13.1–13.8)	10.8 (10.5–11.1)	12.2 (11.5–12.6)	5.7 (5.4–6.0)
				66 km. NE Mérida (6)				
3	196.7 (191.0–200.0)	96.0 (93.0–101.0)	20.5 (20.0–21.0)	27.5 (26.8–28.0)	12.9 (12.7–13.0)	10.5 (10.3–10.7)	12.0 (11.9–12.2)	5.5 (5.2–5.8)

labeled with reference to Esmeralda, and Santa Rosa (7)								
19	194.4 (183.0–212.0)	94.5 (82.0–106.0)	22.3 (18.0–24.0)	29.4 (28.2–30.7)	14.0 (12.6–14.6)	11.4 (10.8–12.1)	12.6 (12.0–13.1)	6.0 (5.3–6.4)
Chichén-Itzá, and specimens labeled with reference to Pisté (8)								
29	201.7 (185.0–219.0)	99.8 (85.0–117.0)	21.8 (20.0–24.0)	29.3 (28.1–30.3)	13.9 (12.9–14.7)	11.4 (10.5–12.3)	12.4 (11.6–13.0)	6.0 (5.3–6.6)
labeled with reference to Pueblo Nuevo X-Can (10)								
8	207.6 (199.0–218.0)	102.1 (97.0–107.0)	22.0 (21.0–24.0)	30.6 (29.8–31.4)	14.1 (13.7–14.7)	12.0 (11.0–12.5)	12.6 (12.3–12.9)	6.2 (5.8–6.5)
La Vega; 5 km. WSW Puerto Juarez; Puerto Morelos (11)								
15	211.1 (190.0–232.0)	108.7 (92.0–122.0)	23.3 (19.0–26.0)	29.1 (28.3–30.1)	13.8 (13.1–14.4)	11.4 (11.0–11.9)	12.4 (11.9–12.7)	5.9 (5.6–6.2)
labeled with reference to Felipe Carrillo Puerto (12)								
6	201.4 (185.0–223.0)	100.2 (92.0–112.0)	21.8 (20.0–23.0)	29.8 (29.3–30.6)	14.0 (13.6–14.5)	11.8 (11.3–12.1)	12.5 (12.2–12.6)	6.0 (5.7–6.3)

A transition zone of deciduous forest lies between scrub and rain forest. Quasi-rain forest extends along the east coast of the peninsula to extreme northern Quintana Roo (see Paynter, 1955:15 and map 2).

Size

All external and cranial measurements of *P. yucatanicus* vary geographically; in cranial characters variation is most pronounced in greatest length of skull, zygomatic breadth, rostral length and length of incisive foramen. The dimensions vary from small in the west to large in the east, irrespective of latitude. The pattern of variation, therefore, is generally clinal in nature, although two exceptions to the clinal distribution were noted. Individuals from La Vega, from 5 km. WSW Puerto Juarez, and from Puerto Morelos, all in northeastern Quintana Roo, are noticeably smaller cranially than individuals taken at Pueblo Nuevo X-Can, situated approximately 75 kilometers to the west. The five specimens from seven and one-half kilometers east of Escárcega (in southwestern Campeche) are significantly larger in external and cranial dimensions than individuals in the sample from Apazote (approximately 60 kilometers to the northeast). Possibly this difference is the result of small sample size.

A comparison of the external and cranial measurements of *P. yucatanicus* from selected localities is presented in Table 2.

I have been unable to correlate changes in external and cranial size with environmental conditions on the peninsula. The facilitation of the genetic change (and therefore speciation), and the adaptive significance of the geographic variation in size are unknown.

Color

Only specimens in winter pelage were used in analyzing geographic variation in color. Mean color reflections of red and green varied from a darker reflectance for individuals from the south (seven kilometers north, 51 kilometers east of Escárcega, red, 10.1, green, 5.5) to a lighter reflectance for specimens from the north (66 kilometers northeast of Mérida, red, 16.6, green, 8.7). Color reflections of specimens from Esmeralda and Santa Rosa (west-central Quintana Roo), approximately equidistant between the above two localities, are intermediate (red, 12.1, green, 6.1). This kind of variation is in keeping with Gloger's Rule (that is to say, darker individuals are present in the more humid parts of the range of a species).

Variation in color coincides closely with vegetative conditions on the peninsula. Although the gradation is generally north-south, I noted at least one exception. Specimens labeled with reference to Pueblo Nuevo X-Can (in northwestern Quintana Roo) are noticeably darker than specimens from localities to the east, north, and west, exhibiting a low reflectance of red and green, presumably due to the effect of the extension of quasi-rain forest northward along the eastern coast of the peninsula.

DISCUSSION AND TAXONOMIC ASSESSMENT OF VARIATION

Two subspecies of *Peromyscus yucatanicus* heretofore have been recognized: *P. y. yucatanicus* (type locality, Chichén-Itzá, Yucatán) and *P. y. badius,* described by Osgood (1904:70-71) on the basis of 19 specimens from Apazote, Campeche. *P. y. badius* was defined by Osgood as: "Similar to *P. yucatanicus* but darker colored."

A comparison of the geographic variation of external and cranial measurements with that of color in *P. yucatanicus* reveals a discordance, because color varies from north (paler) to south (darker), whereas size varies from west (smaller) to east (larger). Three alternatives for expressing nomenclatorially this observed variation occur to me. One alternative would be to recognize four subspecies that would be characterized and distributed as follows: 1) small, dark mice in the southwestern part of the peninsula (central Campeche, localities 1-3 on Fig. 2); 2) relatively small, pale mice from the northwest (localities 4-6); 3) large, usually pale mice from the northeast (localities 7-11); and 4) large, dark mice from southern Quintana Roo (localities 12-14). The second alternative would be to retain the two previously named subspecies, one (*P. y. yucatanicus*) in the north, composed of populations that are generally paler and that are on the average larger than those to the south (*P. y. badius*). The third alternative would be to recognize *P. yucatanicus* as a monotypic species.

The geographic area occupied by the Yucatán deer mouse is relatively small. Infraspecific variation is clinal in nature and not particularly marked. Recognition of any of the variants at the subspecies level would, I think, obscure rather than clarify the variation noted. Four subspecies (alternative one) necessarily would be weakly defined. For example, the mice of the northwestern part of the peninsula (represented in my material by specimens from localities 4-6) differ slightly in color, but not in size, from mice to the south of them (localities 1-3), and differ in the reverse from mice to the east (localities 7-11). Complete intergradation

between mice of the four areas and certain local reversals in the mentioned clines would serve to make such a scheme confusing.

Recognition of two subspecies, one in the south and one in the north, also would produce weak subspecies for several reasons: 1) the area of intergradation would be larger than the area occupied by any one subspecies; 2) there is clinal discordance of size and color; 3) there is local reversal of clinal variation; and 4) no other significant variation is apparant. Therefore, I choose to regard *Peromyscus yucatanicus* as a monotypic species, albeit variable. *P. y. badius* is placed in synonomy under *P. yucatanicus,* which is defined as follows:

Peromyscus yucatanicus J. A. Allen and Chapman

Yucatán Deer Mouse

1897. *Peromyscus yucatanicus* J. A. Allen and Chapman, Bull. Amer. Mus. Nat. Hist., 9:8, February 23 (type locality, Chichén-Itzá, Yucatán).

1904. *Peromyscus yucatanicus badius* Osgood, Proc. Biol. Soc. Washington, 17:70, March 21 (type locality, Apazote, Campeche).

Geographic distribution.—Yucatán Peninsula of Mexico (Yucatán, and all but extreme southern parts of Campeche and Quintana Roo). See Figure 2.

Diagnostic characters.—External: Size medium among species of *Peromyscus* (see Table 2); upper parts brownish (in the south) to ochraceous buff (in the north) with an admixture of dusky; underparts yellowish white; orbital ring narrow, dark; tail dusky above, yellowish below except where blotched with darker pigment. Skull: Size medium; braincase narrow, elongate; supraorbital border slightly beaded; auditory bullae and teeth small; cusps of upper molars with well-developed labial styles and accessory ridges; lower molars having corresponding stylids and ridges. Baculum: Size medium; rod slender, elongate; tip small; base dorsoventrally flattened.

Specimens examined, 213 (localities arranged from north to south in each state).—Campeche: (*3*) Apazote, 18 (USNM); (*1*) 7 km. N, 51 km. E Escárcega, 14; (*2*) 7½ km. W Escárcega, 8. Quintana Roo: (*11*) 5 km. WSW Puerto Juarez, 5 m., 2; (*11*) La Vega, 28 (USNM); (*11*) Puerto Morelos, 1 (USNM); (*10*) Pueblo Nuevo X-Can, 10 m., 12; *1½ km. S, 1 km. E Pueblo Nuevo X-Can,* 1; *2 km. S Pueblo Nuevo X-Can,* 5; (*7*) Santa Rosa, 17 (UMMZ); *1 km. S Santa Rosa,* 2; (*7*) Esmeralda, 8 (UMMZ); *Esmeralda, Laguna Chichancanab,* 1; (*12*) 4 km. NNE Felipe Carrillo Puerto, 20; *2 km. N Felipe Carrillo Puerto,* 5; (*13*) 60 km. N, 16 km. E Chetumal, 3; (*14*) 27 km. NW Chetumal, 1. Yucatan: (*6*) 66 km. NE Mérida, 9; (*9*) 6 km. N Tizimín, 4; (*5*) Mérida Airport, 6 km. S Mérida, 4; (*8*) 3 km. N Pisté, 10 m., 7; *2 km. N Pisté, 12 m.,* 13; *Pisté,* 3; *Cenote Seco, 3 km. E Pisté,* 3; (*8*) Chichén-Itzá, 21 (17 AMNH, 2 USNM, 1 UMMZ); (*4*) Calcehtok, 5 (UMMZ); *Calcehtok, 500 m. N Casa Principal, 10 m.,* 1; *500 m. S Hda. Calcehtok,* 1. Localities not plotted on the accompanying map, Figure 3 (because undue crowding of symbols would have resulted), are in italic type.

Additional records (listed from north to south).—Yucatan (Gaumer, 1917: 117): Silam; Buctzotz; Temax; Tizimín; Izamal; Yaxcach; Xbac. In addition, Hatt (1953:67 and elsewhere) reported remains of *P. yucatanicus* from five cave deposits in southwestern Yucatán.

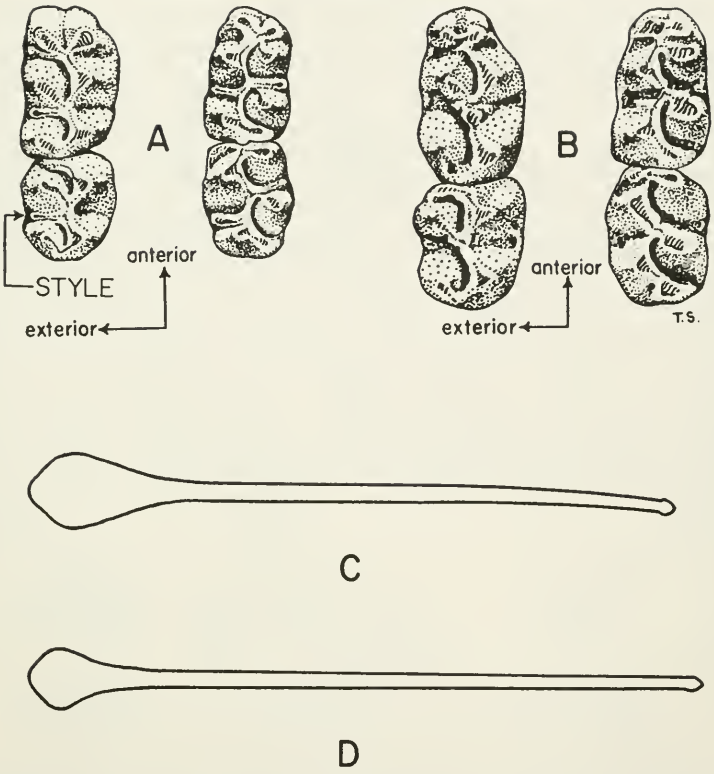

FIG. 1. A and C. *Peromyscus yucatanicus.* A. Occlusal view of M1-2 and m1-2 (KU 92460), × 12. Note the well-developed labial style and accessory ridge. C. Dorsal view of baculum (KU 92442), × 6. Note especially broader base relative to length of bone than in *P. mexicanus.* B and D. *Peromyscus mexicanus.* B. (KU 66888), × 12. D. (KU 66899), × 6.

Remarks.—Gaumer (*loc. cit.*) reported *P. yucatanicus* from Cozumel Island, but Koopman (1959:237) suspected that the specimens involved were instead *P. leucopus.* That Koopman probably was correct is evidenced by the fact that a field party from The University of Kansas took no *P. yucatanicus* on Cozumel Island in the summer of 1962, although several specimens of *P. leucopus* were taken.

It is noteworthy that Percy L. Clifton obtained no specimens of *P. yucatanicus* when he collected mammals at several places in rain forest along the southern borders of Campeche and Quintana Roo in 1963. Therefore, the southernmost records of the species herein reported probably approximate the margin of the range.

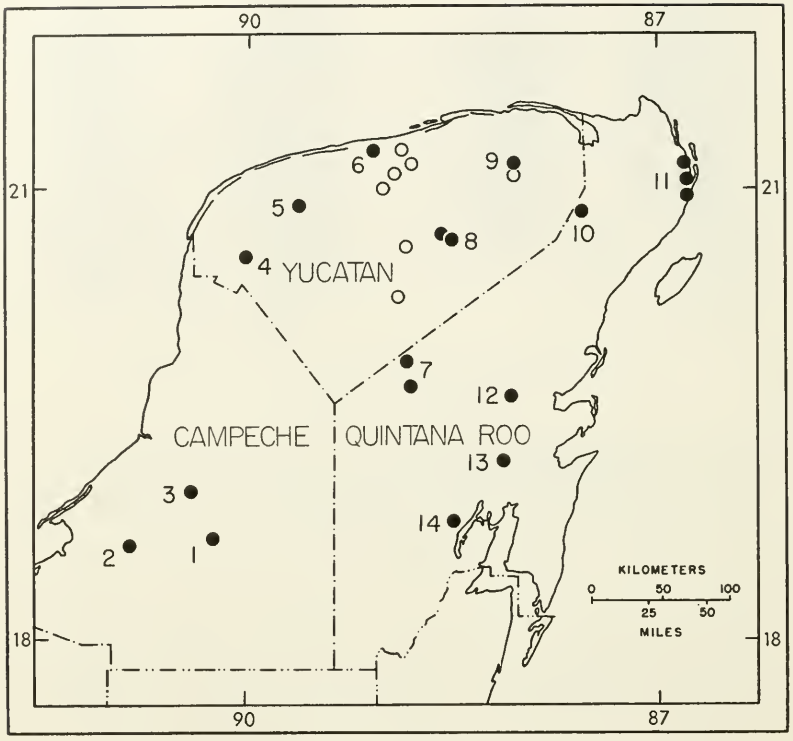

FIG. 2. Map showing the geographic distribution of *Peromyscus yucatanicus*. The numbers identify localities listed on page 432, in the paragraph of *"Specimens examined."* Solid circles represent localities from which specimens were examined; open circles are records from the literature.

There are two instances in the literature in which misnomers have been applied to *P. yucatanicus*. Hooper (1957:36) employed the name of *P. yucatanensis,* and Koopman (1959:237) used *P. yucatanica.*

NATURAL HISTORY

Habitat.—The preferred habitat of *P. yucatanicus* seems to be thick brushy or forested areas, but the species has been trapped also in overgrown milpas (grain fields), and in dense grassy situations. Goldman (1951:337) recorded *yucatanicus* as occurring within the Arid Subzone of the Lower Tropical Life-zone. Recent records of capture indicate that the species occurs also in the Humid Subzone. *P. yucatanicus* is restricted to the Yucatán Peninsula Biotic Province as defined by Goldman and Moore (1946:360).

Associated species.—Species of rodents caught in the same trapline with *P. yucatanicus* include *Heteromys gaumeri, Ototylomys phyllo-*

tis, Oryzomys alfaroi, O. melanotis, Sigmodon hispidus, Mus musculus, and *Peromyscus leucopus.* The ecological separation of *P. yucatanicus* from the above-mentioned species is most likely determined by the local environmental conditions and the number of species present. Of the two most common associates, *Ototylomys phyllotis* is primarily arboreal in habits, whereas *Heteromys gaumeri* generally inhabits denser vegetation than *P. yucatanicus* where the two species occur together (collected field notes, Museum of Natural History, The University of Kansas). Where *P. yucatanicus* and *P. leucopus* occur in the same areas, *yucatanicus* is commonly present in dense forested situations, whereas *leucopus* is found along roads, in coconut fields, and around borders of milpas.

Reproduction.—Available evidence suggests that the Yucatán deer mouse breeds the year around. Information recorded on specimen labels concerning pregnant or lactating females is as follows (measurements of embryos, in millimeters, indicate crown-rump length):

Female	*Data*	*Date*
KU 93732	3 embs x 16	22 April
KU 92437	3 embs x 15	15 July
KU 92456	lactating, with placental scars	21 July
KU 92492	3 embs x 10	31 July
KU 92496	lactating	15 August
KU 92499	3 embs x 22	15 August
KU 93720	3 embs x 9	26 December

Juvenal mice have been taken in March, July, August, November, and December.

Parasites.—External parasites were collected from several specimens of *P. yucatanicus* by a University of Kansas field party on the Yucatán Peninsula in the summer of 1962. The following parasites have thus far been identified: louse, *Hoplopleura hesperomydis* (from KU 92471, female); ticks, *Ixodes* sp. (from KU 92461, female) and *Amblyamma cajennense* (from KU 92454, male).

EVOLUTION AND SPECIATION

The genus *Peromyscus* is generally considered to have originated no earlier than early Pliocene (Simpson, 1945:84; Wilson, 1937:50). If it can be assumed that the original area of development of a genus is indicated by the presence today of many more or less specialized species, then radiation of the genus *Peromyscus* may have taken place in central México.

Peromyscus yucatanicus is closely related to *P. mexicanus* as indicated by several characters. *P. yucatanicus* probably evolved from

a *Peromyscus mexicanus*-like stock, the progenitors of which are unknown.

No evolutionary or paleontological evidence is available for elucidating the formation of *P. yucatanicus*. Divergence of *yucatanicus* and *mexicanus* from each other may have resulted from peninsular and ecological isolation, but major physiographic or climatic barriers are not known to have separated the Yucatán Peninsula from the main axis of México subsequent to the formation of the genus.

Present distributional patterns of *P. yucatanicus* and *P. mexicanus* suggest divergence of the two species by ecological separation associated with vegetational changes. *P. mexicanus* is primarily a forest dweller of highland areas; the species is generally uncommon on the coastal plain (Hall and Dalquest, 1963:309). The habitat of *P. yucatanicus* is arid deciduous and quasi-rain forest, and scrub. Both species seem intolerant of tropical rain forest. During one of the glacial periods in the Pleistocene the progenitor of the two species may have inhabited a continuous area encompassing the eastern mountainous and coastal regions of central México. As deglaciation occurred, tropical rain forest may have proliferated along the eastern coast of México, separating two large segments of the range and forming a barrier to gene flow. Subsequently, *P. yucatanicus* and *P. mexicanus* could have diverged.

The fact that the smallest representatives of *P. yucatanicus* are found at the margin of the range that is nearest geographically to the range of *P. mexicanus* suggests that character displacement probably occurred. In this regard, sympatry could have resulted later in the Pleistocene when deglaciation caused a partial submergence of the Yucatán Peninsula (Paynter, 1955:10). At that time a limited amount of habitat would have been available, and the range of *yucatanicus* may have shifted southward, where it came in contact with that of the parental stock. This hypothesis would appear to discount the tropical rain forest as being a totally effective barrier to dispersal of *yucatanicus* and *mexicanus*. Perhaps the restriction of habitat during deglaciation necessitated an invasion by *yucatanicus* of less tolerable situations than those normally occupied.

Character displacement possibly occurred only recently, and the gap between the ranges of *P. yucatanicus* and *P. mexicanus* may be simply an artifact, namely lack of knowledge of the fauna of the area. Speciation probably occurred before the Wisconsin glaciation, since it seems that insufficient time has elapsed after the last

glacial period for the differentiation of *yucatanicus,* subsequent meeting of its range with that of *mexicanus,* and the development of character displacement.

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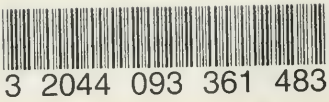
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